Bridge Design Memorandums **Table of Contents 1**

As of July 7, 2011

YEAR	MEMO	PDF_FILE	DESCRIPTION
2006	DM0106	DM200601.PDF	SCDOT Bridge Design Manual
2006	DM0206	DM200602.PDF	End Bent/End Wall Reinforcing Steel
2006	DM0306	DM200603.PDF	Design Manual Errata: Section Properties for Prestressed Concrete Beams
2007	DM0107	DM200701.PDF	Drilled Shaft Reinforcing Steel
2007	DM0207	DM200702.PDF	Processing Shop Plans
2007	DM0307	DM200703.PDF	CSX Transportation Criteria for Overhead Bridges
2007	DM0407	DM200704.PDF	Review of Structural Plans and Reports by Preconstruction Support
2008	DM0108	DM200801.PDF	Design of Prestressed Concrete Girders
2008	DM0208	DM200802.PDF	Revised Bridge Title Sheets
2008	DM0308	DM200803.PDF	Revised Prestressed Concrete Cored Slab Drawings
2008	DM0408	DM200804.PDF	Adhesively Bonded Anchors and Dowels
2008	DM0508	DM200805.PDF	SCDOT Geotechnical Design Manual and Updated SCDOT Seismic Design Specifications of Highway Bridges
2008	DM0608	DM200806.PDF	SCDOT Seismic Design Specifications for Highway Bridges, Version 2.0 Corrections to Equations 9-1 and 9-2
2009	DM0109	DM200901.PDF	Exceptions to SCDOT Structural Design Criteria
2009	DM0209	DM200902.PDF	Steel H-Pile Anchorage Detail - Figure 19.2-2 of the SCDOT Bridge Design Manual
2009	DM0309	DM200903.PDF	Guardrail-To-Bridge-Rail Transitions - Section 17.6.1.3 of the SCDOT Bridge Design Manual
2009	DM0409	DM200904.PDF	SCDOT Americans with Disabilities Act Transition Plan
2009	DM0509	DM200905.PDF	Section 17.6.1.5 of the SCDOT Bridge Design Manual
2010	DM0110	DM201001.PDF	Section 11.3.9 of the SCDOT Bridge Design Manual
2010	DM0210	DM201002.PDF	SCDOT Geotechnical Design Manual - Version 1.1
2010	DM0310	DM201003.PDF	SCDOT Geotechnical Design Manual, Version 1.1 - Revisions to Chapter 9, Chapter 16, and Appendix A
2010	DM0410	DM201004.PDF	SCDOT Bridge Design Manual - Revisions to Chapter 6
2010	DM0510	DM201005.PDF	SCDOT Geotechnical Design Manual, Version 1.1 - Revisions to Chapter 21
2011	DM0111	DM201101.PDF	Drilled Shafts - Revisions to Sections 12.5.3.2, 15.3.1.2, 19.3.3, and 20.3.2.1 of the SCDOT Bridge Design Manual and Sections 16.4 and 22.2.1.2 of the SCDOT Geotechnical Design Manual
2011	DM0211	DM201102.PDF	SCDOT Geotechnical Design Manual, Version 1.1 - Revisions to Chapters 4, 8, 9, 10, and 17

South Carolina
Department of Transportation

DM0106

June 7, 2006

MEMORANDUM TO TEAM LEADERS AND CONSULTANTS

SUBJECT: *SCDOT Bridge Design Manual*

Effective July 1, 2006, all new bridge designs shall comply with the requirements of the *SCDOT Bridge Design Manual*. Projects currently in the design phase should also comply with the requirements of the *Manual*, unless the design and detailing are substantially complete. Bridge Design Memorandums dated prior to April 2006 will not apply to projects being designed using the criteria of the *Manual*.

The *Manual* may be viewed or downloaded from the Department's website at www.scdot.org/doing. Copies may also be obtained, at a cost of $75.00 per manual, through the Department's Engineering Publications Office at (803) 737-4533 or at engrpubsales@dot.state.sc.us.

As the need arises, Bridge Design Memorandums will be issued to supplement or revise the requirements of the *Manual*. These memorandums will supersede the contents of the *Manual* and will be posted on the Department's website.

Mitchell D. Metts, P.E.
Bridge Design Engineer

cc: Assistant Bridge Design Engineers
Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer

File: PC/BWB

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South Carolina
Department of Transportation

DM0206

October 17, 2006

MEMORANDUM TO TEAM LEADERS AND CONSULTANTS

SUBJECT: End Bent/End Wall Reinforcing Steel

Prior to the pouring of the end wall concrete, the ends of straight reinforcing steel, projecting vertically from the end bent cap, present an impalement hazard to workers. To eliminate the hazard, the Contractor must use protective devices to cover the ends of the bars. Therefore, whenever it is practical to do so, detail a standard 180 degree hook at the end of the projecting reinforcing steel. See the attached example showing this preferred detail.

The requirements of this memorandum are considered to be a supplement to the requirements of the *SCDOT Bridge Design Manual.* The *Manual* will be updated at a later date to reflect these requirements.

Mitchell D. Metts, P.E.
Bridge Design Engineer

Attachment

cc: Assistant Bridge Design Engineers
Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer

File: PC/BWB

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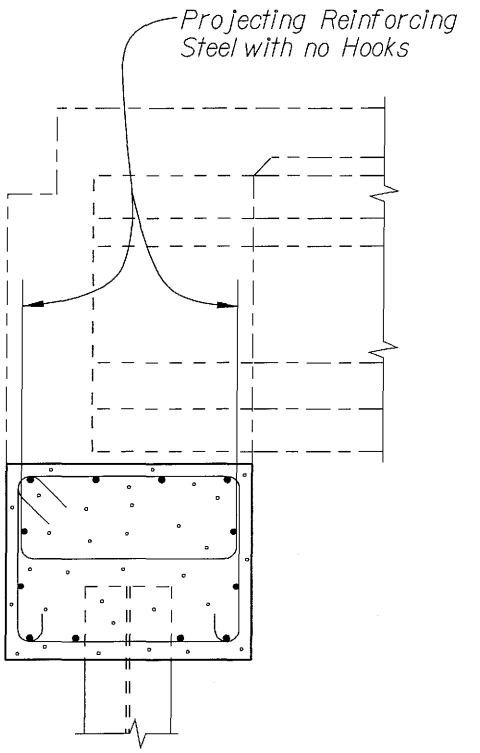
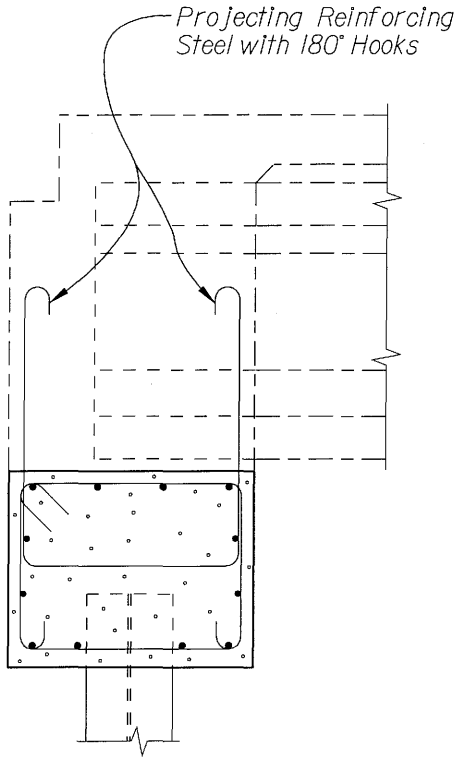


DETAIL WITH STRAIGHT
REINFORCING STEEL



PREFERRED DETAIL
WITH HOOKS

SECTION THRU END BENT CAP

Note:
Reinforcing steel arrangement is shown to illustrate the use of the 180° hooks only. Reinforcing steel details will vary depending on items such as end wall dimensions, girder size, girder type, and loading requirements.

South Carolina
Department of Transportation

DM0306

November 14, 2006

MEMORANDUM TO TEAM LEADERS AND CONSULTANTS

SUBJECT: Design Manual Errata
Section Properties for Prestressed Concrete Beams

Figure 15.5-1 (on pages 15-30 and 15-31) of the *SCDOT Bridge Design Manual* shows dimensions and section properties for prestressed concrete beams. The section properties for the Type I Modified Beam and the 54" Modified Bulb-Tee Beam are not correct. The correct values are indicated below:

Type I Modified Beam
$I = 26{,}495\ in^4$

54" Modified Bulb-Tee
$A = 707\ in^2$
$W = 737\ plf$
$Y_{TOP} = 26.21"$
$Y_{BOT} = 27.79"$
$I = 277{,}560\ in^4$

Please make the appropriate corrections to your copy of the *Manual.*

Mitchell D. Metts, P.E.
Bridge Design Engineer

cc: Assistant Bridge Design Engineers
Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer

File: PC/BWB

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South Carolina
Department of Transportation

DM0107

February 9, 2007

MEMORANDUM TO TEAM LEADERS AND CONSULTANTS

SUBJECT: Drilled Shaft Reinforcing Steel

The existing requirements of Section 15.3.1.3.2 of the *SCDOT Bridge Design Manual* shall be replaced with the following:

> For both parallel longitudinal reinforcing bars and parallel transverse reinforcing bars, the clear distance between bars shall not be less than five times the maximum aggregate size or 5 inches. When bundled bars are used, consideration shall be given to increasing these minimum clear spacing requirements.

Please note this revision in your copy of the *Manual.*

Mitchell D. Metts, P.E.
Bridge Design Engineer

cc: Assistant Bridge Design Engineers
Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer

File: PC/BWB

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South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0207

TO: RPG Structural Engineers
Structural Design Consultants

DATE: September 28, 2007

RE: Processing Shop Plans

Due to the reorganization of the Preconstruction Division, the Department has revised its internal process for handling shop plans. The attached flowcharts show the detailed steps of the Department's new shop plan review process.

Items 1 and 2 in Section 24.1.2 of the *SCDOT Bridge Design Manual* shall be deleted and replaced with Items 1 and 2 shown below:

1. Shop Plans (In-House Designed Projects) The Contractor submits seven sets of the shop plans to the SCDOT Preconstruction Support Engineer. The Logistics Coordinator of the Preconstruction Support Group forwards the plans to the appropriate Regional Production Group for review. After review, the Regional Production Group returns six sets of the shop plans to the Logistics Coordinator. The Logistics Coordinator retains one set of the shop plans for the file and distributes:
    - one set to the Contractor,
    - two sets to the SCDOT Resident Construction Engineer, and
    - two sets to the SCDOT Materials and Research Engineer.

2. Shop Plans (Consultant Designed Projects) The Contractor submits seven sets of the shop plans directly to the Consultant. After the Consultant reviews the shop plans, the Consultant submits six sets of the shop plans to the SCDOT Preconstruction Support Engineer, not the Contractor. The Logistics Coordinator of the Preconstruction Support Group forwards the plans to the appropriate Regional Production Group for review. After review, the Regional Production Group returns six sets of the shop plans to the Logistics Coordinator. The Logistics Coordinator retains one set of the shop plans for the file and distributes:
    - one set to the Contractor,
    - two sets to the SCDOT Resident Construction Engineer, and
    - two sets to the SCDOT Materials and Research Engineer.

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Shop plan submittals to the Department should be forwarded to the following address:

South Carolina Department of Transportation
Preconstruction Support Engineer
955 Park Street - Room 409
Columbia, South Carolina 29201

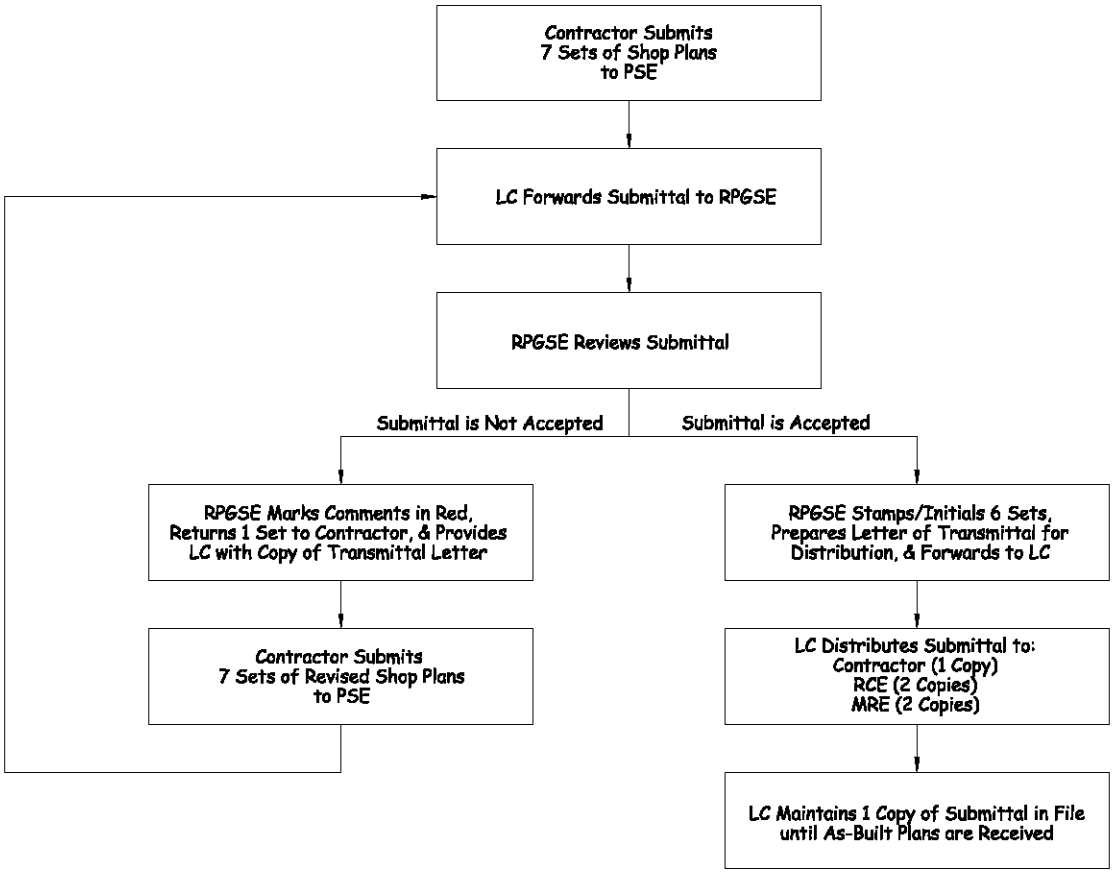
Attention: Logistics Coordinator

Barry W. Bowers
Structural Design Support Engineer

Attachments

cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Engineer
Regional Production Engineers
RPG Design Managers

File: PC/BWB

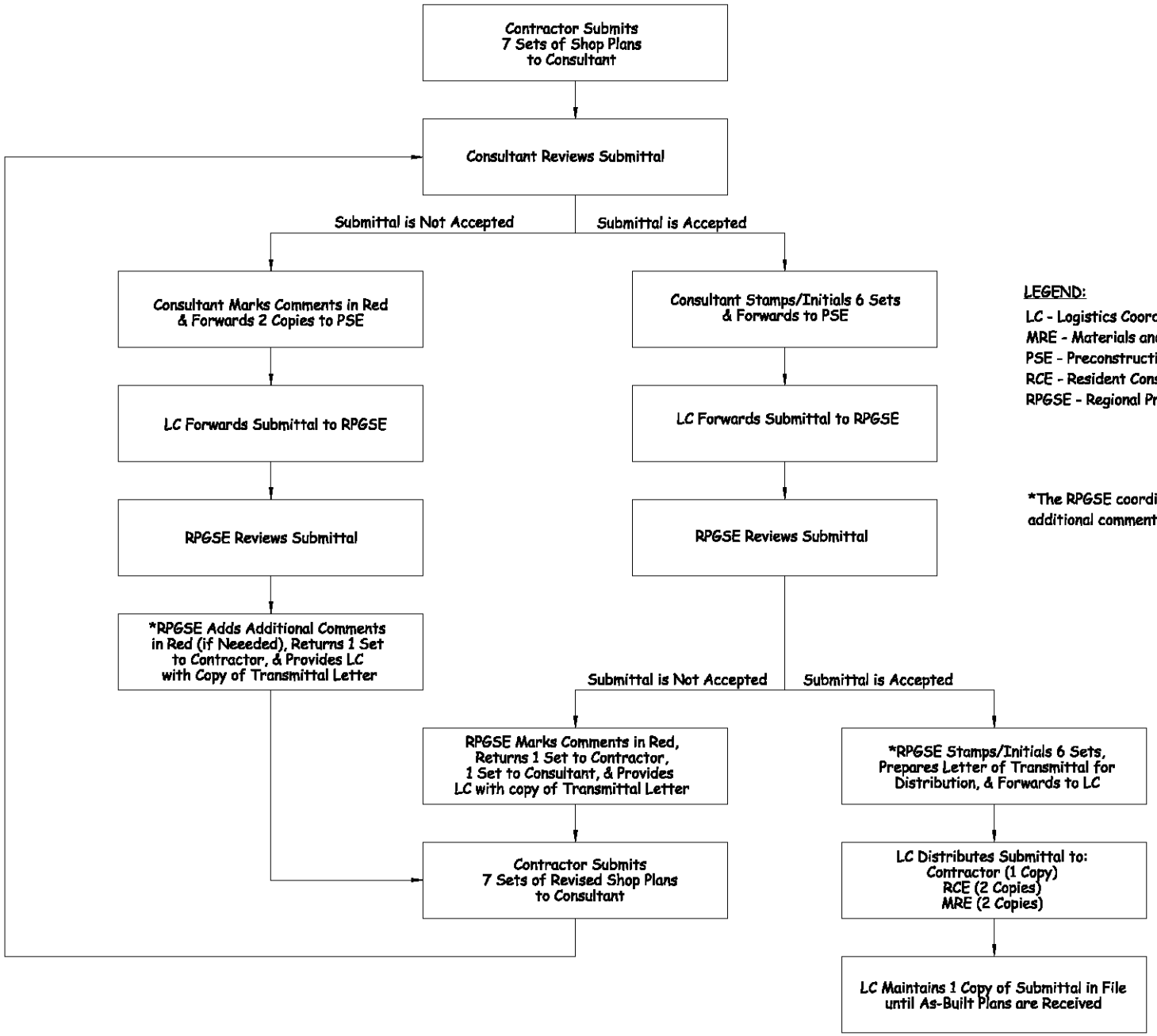


FLOWCHART FOR PROCESSING SHOP PLANS

IN-HOUSE DESIGNED PROJECTS

LEGEND:

LC - Logistics Coordinator - Preconstruction Support Group
MRE - Materials and Research Engineer
PSE - Preconstruction Support Engineer
RCE - Resident Construction Engineer
RPGSE - Regional Production Group Structural Engineer



LEGEND:

LC - Logistics Coordinator - Preconstruction Support Group
MRE - Materials and Research Engineer
PSE - Preconstruction Support Engineer
RCE - Resident Construction Engineer
RPGSE - Regional Production Group Structural Engineer

*The RPGSE coordinates with the Consultant if additional comments are added.

FLOWCHART FOR PROCESSING SHOP PLANS

CONSULTANT DESIGNED PROJECTS

SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION

Attachment 2 Bridge Design Memorandum DM0207

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0307

TO: RPG Structural Engineers
Structural Design Consultants

DATE: September 28, 2007

RE: CSX Transportation Criteria for Overhead Bridges

As indicated in Sections 22.2.1 and 22.2.4 of the *SCDOT Bridge Design Manual*, the Department considers the criteria established by the individual railroad companies when designing highway bridges over railroads. The attached CSX Transportation (CSXT) "Criteria for Overhead Bridges," dated September 14, 2007, shall be used when preparing designs for projects that involve bridge work over CSXT's railroad tracks.

Where there are conflicts with the CSXT criteria and the requirements of the *Manual*, the more conservative requirement shall be used for design. For projects where designs are complete or are substantially complete and where the designs do not fully comply with all of the revised CSXT requirements, the designer will coordinate with the Department's Railroad Projects Manager to determine if revisions are needed.

Barry W. Bowers
Structural Design Support Engineer

Attachment

cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Engineer
Railroad Projects Manager
Regional Production Engineers
RPG Design Managers
Rights of Way Administrator

File: PC/BWB

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CSX TRANSPORTATION

CRITERIA FOR OVERHEAD BRIDGES

Office of Director Fixed Plant Engineering
Jacksonville, Florida
Date Issued: September 14, 2007

CRITERIA FOR OVERHEAD BRIDGES

CSX Transportation (CSXT) has minimum requirements for outside parties constructing, rehabilitating, or replacing bridges over CSXT's railroad tracks. These requirements are intended to provide safe and continuous passage of all train traffic during and after construction of bridges over its tracks. Part of these requirements is for the outside party to submit a detailed plan of the project as well as provide details of the construction methodology. This document provides information on the requirements by CSXT for overhead bridges.

Plans and specifications for new or reconstructed bridges over CSXT's railroad tracks or right-of-way shall meet the following requirements:

I. GENERAL REQUIREMENTS:

A. CSXT's valuation station and the distance from the nearest milepost at the intersection of the centerline of the track and the centerline of the bridge shall be shown on the General Plan.

B. The existing and proposed minimum horizontal and vertical clearances shall be marked clearly on the General Plan and Elevation.

C. At least one subsurface exploration boring for each substructure unit adjacent to the track shall be furnished to CSXT's during the design submittal. Borings shall provide enough information to design shoring and foundations.

D. Prior to construction activities, all overhead bridge projects will require the procurement of the appropriate property rights from CSX Real Property and other construction agreement(s) with CSX Transportation.

E. All lifting equipment and connection devices shall have capacity for 150% of the actual lifting load. The factor of safety provided by the manufacturer in the lifting capacity data shall not be considered in the 150% requirement. A licensed professional engineer, familiar with lifting and rigging, in the State where the construction work is proposed must sign and seal all plans and calculations related to critical lifting on the project.

II. CLEARANCES:

A. Horizontal Clearance: Standard horizontal clearance from centerline of the track to the face of the pier or abutment shall typically be 25'-0" or greater, but never less than 18'-0", measured perpendicular to the track. Provisions for future tracks, access roads, other CSXT facilities, and drainage may require the minimum clearance be increased or use of multi-span structures. The toe of footings shall not be closer than 11'-0" from centerline of the track to provide adequate room for sheeting.

B. Vertical Clearance: A standard vertical clearance of 23'-0" shall be provided, measured from top of high rail to lowest point of structure in the horizontal clearance area which extends 6'-0" either side of the centerline of track.

C. Temporary Construction clearances to be used shall be subject to approval by CSXT. Typically reductions in clearance for construction are not permitted.

D. CSXT shall be furnished as-built drawings showing actual clearances as constructed.

III. CRASHWALLS:

AREMA Specifications, Chapter 8, Article 2.1.5 covers the requirements for crashwalls. Crashwalls are required when face of the pier is closer than 25'-0" from centerline of the track, measured perpendicular to the track, except as noted below.

Crashwalls shall meet the following requirements:

A. Crashwalls for single column piers shall be minimum 2'-6" thick and shall extend a minimum of 6'-0" above the top of high rail for piers located between 18'-0" and 25'-0" from the centerline of the nearest track. The wall shall extend minimum 6'-0" beyond the column on each side in the direction parallel to the track.

B. For multi-column piers, the columns shall be connected with a wall of the same thickness as the columns or 2'-6" whichever is greater. The wall shall extend a minimum of 2'-6" beyond the end of outside columns in a direction parallel to the track.

C. Reinforcing steel to adequately anchor the crashwalls to the column and footing shall be provided.

For piers of heavy construction, crashwalls may be omitted. Solid piers with a minimum thickness of 2'-6" and length of 20'-0", single column piers of minimum 4'-0" X 12'-6" dimensions or any other solid pier sections with equivalent cross sections and minimum 2'-6" thickness are considered as heavy construction.

IV. DRAINAGE:

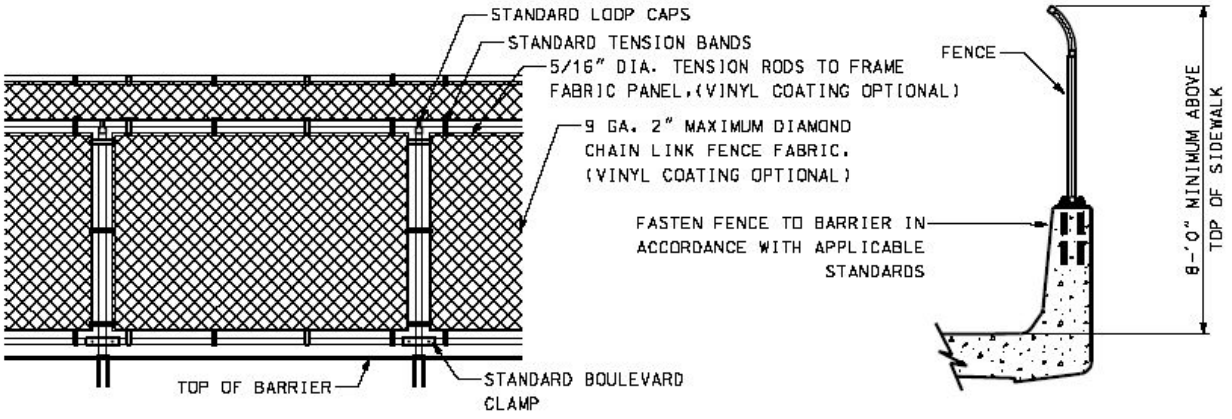
Drainage from the bridge shall be preferably collected with drain pipes and drained away from CSXT's right-of-way. When open scuppers are provided on the bridge, none shall be closer than 25'-0" of the centerline of nearest track. Flow from the scuppers shall be directed away from CSXT's drainage ditches.

Projects including stormwater systems shall be designed for a 100-year storm event as a minimum. If stormwater is drained on or to CSXT's right-of-way, calculations must be submitted to CSXT to verify the 100-year storm event is properly handled. Improvements to the adjacent drainage systems may be required at project expense, to ensure the impacted system will meet the 100-year storm event minimum condition.

During and after completion of construction, the outside party or its contractor must clear CSXT's drainage ditches of all debris to the satisfaction of CSXT's construction engineering and inspection representative

V. PROTECTIVE FENCING

All highway structures shall have a protective barrier fence to extend at least 8'-0" from the top of the sidewalk or driving surface adjacent to the barrier wall. The fence may be placed on top of the barrier wall. The fence shall be capable of preventing pedestrians from dropping debris onto CSXT's right-of-way, and in particular, passing trains. Openings in the fence shall not exceed 2"x2". Fencing should also include anti-climb shields or be of a configuration to minimize the likelihood of climbing on the outside of the protective fencing. A chain link fence option is shown below:



VI. STRUCTURE EXCAVATION AND SHORING:

Shoring protection shall be provided when excavating adjacent to an active track. Shoring will be provided in accordance with AREMA *Manual for Railway Engineering* Chapter 8 part 28, except as noted below.

Shoring will not be required if both the following conditions are satisfied:

1. Excavation does not encroach upon a 1 ½ horizontal: 1 vertical theoretical slope line starting 1'-6" below top of rail and at 12'-0" minimum from centerline of the track (live load influence zone).

2. Track is on level ground or in a cut section and on stable soil.

When the track is on an embankment, excavating the toe of the embankment without shoring may affect the stability of the embankment. Therefore, excavation of the embankment toe without shoring will not be permitted.

Preferred protection is the cofferdam type that completely encloses the excavation. Where dictated by conditions, partial cofferdams with open sides away from the track may be used. Cofferdams shall be constructed using steel sheet piling or steel soldier piles with timber lagging. Wales and struts shall be provided as needed. The following shall be considered when designing cofferdams:

a. Shoring shall be designed to resist a vertical live load surcharge of 1,882 lbs. per square foot, in addition to active earth pressure. The surcharge shall be assumed to act on a continuous strip, 8'-6" wide. Lateral pressures due to surcharge shall be computed using the strip load formula shown in AREMA *Manual for Railway Engineering*, Chapter 8, Part 20.

b. Allowable stresses in materials shall be in accordance with AREMA *Manual for Railway Engineering*, Chapter 7, 8, and 15.

c. A construction procedure for temporary shoring shall be shown on the drawing.

d. Safety railing shall be installed when temporary shoring is within 15'-0" of the centerline of the track.

e. A minimum distance of 10 feet from centerline of the track to face of nearest point of shoring shall be maintained.

The contractor shall submit the following drawings and calculations for CSXT's review and approval.

1. Three (3) sets of detailed drawings of the shoring systems showing sizes of all structural members, details of connections, and distances form centerline of track to face of shoring. Drawing shall show a section showing height of shoring and track elevation in relation to bottom of excavation.

2. One set of calculations of the shoring design.

   The drawings and calculations shall be prepared by a Licensed Professional Engineer in the State where shoring is to be constructed and shall bear his seal and signature. Shoring plans shall be approved by CSXT's construction engineering and inspection representative.

3. For sheeting and shoring within 18'-0" of the centerline of the track, the live load influence zone, and in slopes, the contractor shall use sheet pile. No sheet pile in slopes or within 18'-0" of the centerline of track shall be removed. Sheet piles shall be cut off 3'-0" below the finished ground line. The remaining 3'-0" shall be backfilled and compacted immediately after cut off.

VII. DEMOLITION OF EXISTING STRUCTURE:

The Contractor shall submit a detailed procedure for demolition of existing structures over or adjacent to CSXT's tracks or right-of-way. The procedure shall clearly indicate the capacity of cranes, location of cranes with respect to the tracks and calculated lifting loads (refer to Section I.E of this document). The demolition procedure must be approved by CSXT's construction engineering and inspection representative.

CSXT's tracks, signals, structures, and other facilities shall be protected from damage during demolition of existing structure or replacement of deck slab. As a minimum, both of the following methods shall be used:

A. During demolition of the deck, a protection shield shall be erected from the underside of the bridge over the track area to catch falling debris. The protection shield shall be supported from girders or beams. The deck shall be removed by cutting it in sections and lifting each section out. The protection shield shall be designed, with supporting calculations, for a minimum of 50 pounds per square foot plus the weight of the equipment, debris, personnel, and other loads to be carried.

   Large pieces of deck shall not be allowed to fall on the protection shield

B. A ballast protection system consisting of geofabric or canvas shall be placed over the track structure to keep the ballast clean. The system shall extend along the track structure for a minimum of 25'-0" beyond the limits of the demolition work, or farther if required by CSXT's construction engineering and inspection representative.

C. The Contractor shall submit detailed plans, with supporting calculations, of the protection shield and ballast protection systems for approval prior to the start of demolition.

D. Blasting will not be permitted to demolish a structure over or within CSXT's right-of-way.

VIII. ERECTION PROCEDURE:

The Contractor shall submit a detailed procedure for erecting over or adjacent to CSXT's tracks or right-of-way. The procedure shall clearly indicate the capacity of cranes, location of cranes with respect to the tracks and calculated lifting loads (refer to Section I.E of this document). The erection procedure must be approved by CSXT's construction engineering and inspection representative.

IX. PILE INSTALLATION

A. For the installation of piles and sheeting for abutment foundations, pier foundations, retaining wall foundations, temporary and permanent shoring and other structures on or adjacent to CSXT's right-of-way, the contractor may be required to submit a detailed track monitoring program for CSXT's approval prior to performing any work near CSXT's right-of-way.

B. The program shall specify the survey locations, the distance between the location points, and frequency of monitoring before, during, and after construction. CSXT shall have the capability of modifying the survey locations and monitoring frequency as needed during the project.

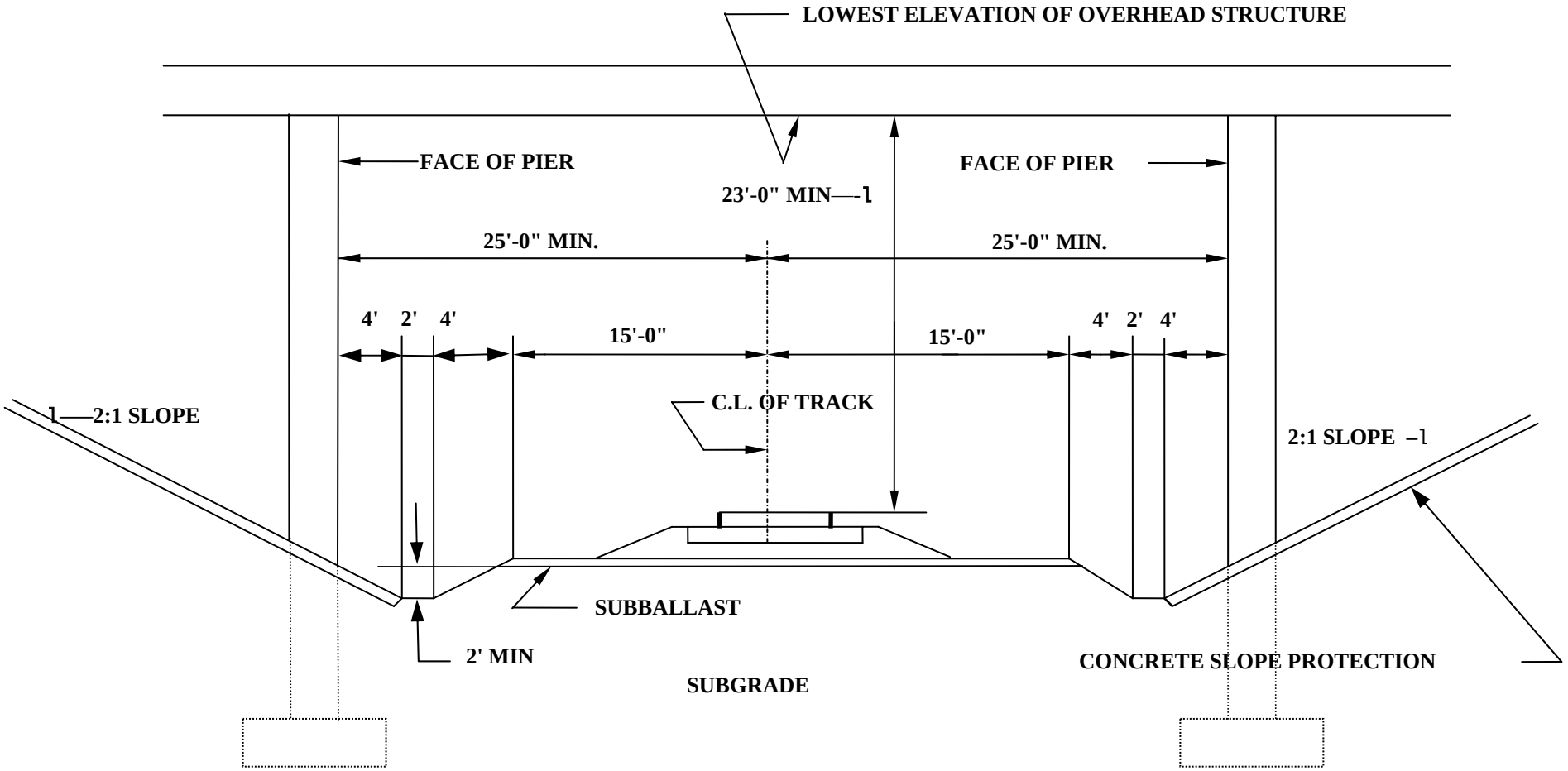
C. If any settlement is observed, CSXT's construction engineering and inspection representative shall be immediately notified. CSXT, at its sole discretion, shall have the right to immediately require all contractor operations to be ceased, have the excavated area immediately backfilled and/or determine what corrective action is required. Any corrective action required by CSXT or performed by CSXT including the monitoring of corrective action of the contractor will be at project expense.

X. PEDESTRIAN OVERHEAD

Pedestrian overhead bridges shall be governed by this document in its entirety with the following exceptions:

A. Pedestrian overhead bridges shall span the entire width of CSXT's right-of-way. Intermediate piers or other supports will not be permitted.

B. Pedestrian overhead bridges shall be completely enclosed with protective canopy or by other means to prevent users from dropping debris onto CSXT's right-of-way.

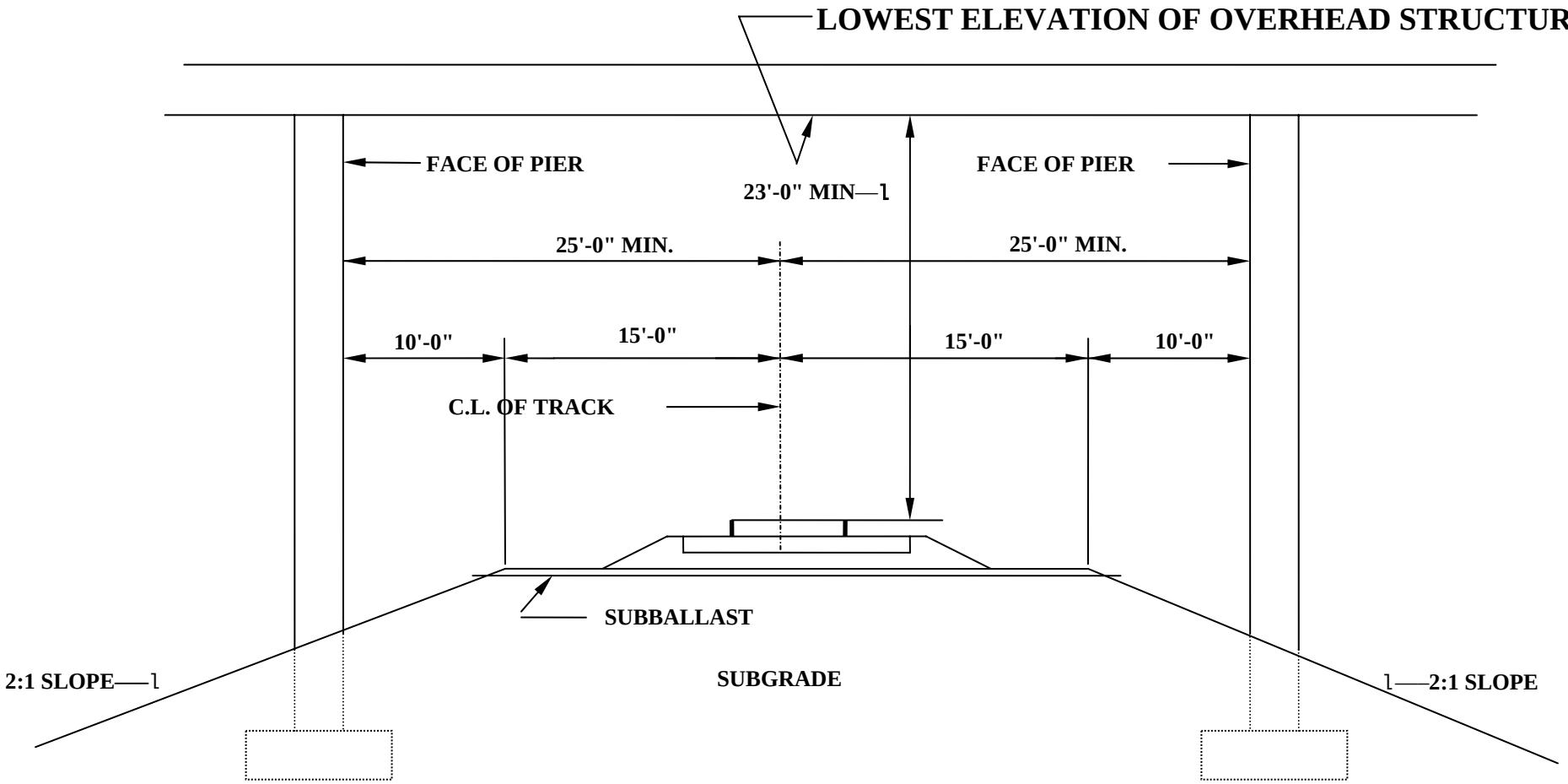


CLEARANCES REQUIRED FOR OVERHEAD STRUCTURES
TYPICAL ROADBED SECTION WITH STANDARD DITCHES

NOTE: **FOR MULTIPLE TRACKS, STANDARD TRACK CENTERS IS 15'-0". AN ADDITIONAL 8'-0" WIDE ACCESS ROAD MAY BE REQUIRED TO PROVIDE 33'-0" MINIMUM DISTANCE FROM CENTERLINE OF TRACK TO FACE OF PIER.**

CSX ENGINEERING DEPARTMENT

STANDARD CLEARANCES FOR OVERHEAD STRUCTURES



CLEARANCES REQUIRED FOR OVERHEAD STRUCTURES
TYPICAL SECTION FOR ROADBED IN FILL

(WHERE NO DEFINED DITCHES ARE NEEDED)

CSX ENGINEERING DEPARTMENT

STANDARD CLEARANCES FOR OVERHEAD STRUCTURES

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0407

TO: RPG Structural Engineers
Structural Design Consultants

DATE: December 20, 2007

RE: Review of Structural Plans and Reports by Preconstruction Support

Structural plans and reports developed by the Regional Production Groups (RPG) and their Consultants will be reviewed by the Structural Design Support Group of Preconstruction Support. The RPG should submit the following plans and reports to the Structural Design Support Engineer:

- Conceptual Bridge Plans (when applicable)
- Preliminary Bridge Plans
- 60% Bridge Plans (when applicable)
- 95% Bridge Plans
- Seismic Design Reports (when applicable)
- Preliminary Geotechnical Reports (Road and Bridge)
- Final Geotechnical Reports (Road and Bridge)
- Right of Way Plans for Retaining Walls and Culverts
- Construction Plans for Retaining Wall and Culverts
- Contractor proposed Value Engineering Plans involving Structures or Embankments

The Structural Design Support Group will review the above submittals for application of designs and for consistency with design specifications and Department policies. In-depth reviews, for both in-house and consultant submittals, should be performed by the RPG.

When requested, the Structural Design Support Group will also participate on design review teams in support of RPG design/build projects, participate on Value Engineering teams, review structural plans in response to county sales tax initiatives, review encroachment permits, and provide preliminary scoping reviews for project development and maintenance activities.

At any point during the project development process, designers may request from the Structural Design Support Group technical reviews of details or designs. For project-specific issues, Consultant designers should coordinate with the RPG when making such requests.

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File:PC/ESE

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South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0108

TO: RPG Structural Engineers
Structural Design Consultants

DATE: January 8, 2008

RE: Design of Prestressed Concrete Girders

The first and second paragraphs of Section 15.5.6.1 of the *SCDOT Bridge Design Manual* shall be replaced with the following:

> This Section addresses the general design theory and procedure for precast, prestressed (pre-tensioned) concrete girders. Although SCDOT design requirements differ somewhat, design examples can be found in Chapter 9 of the *PCI Bridge Design Manual.*
>
> Where practical, multiple span bridges composed of precast, prestressed concrete girders should be detailed as continuous with continuity diaphragms at interior supports to eliminate expansion joints in the deck slab. When precast, prestressed concrete girders are detailed as continuous for live load and superimposed dead load, the following apply:
>
> - All structural components shall be designed for the more critical condition of either assuming a fully effective connection at the continuity diaphragm (fully continuous span) or assuming complete loss of continuity (simple spans).
>
> - Restraint moments caused by girder creep and shrinkage may be neglected.
>
> - A positive moment connection shall be provided with a factored resistance, φM_n, of not less than 1.2 M_{cr}, as specified in AASHTO LRFD Article 5.14.1.4.9. See the *SCDOT Bridge Drawings and Details* (available at the SCDOT website) for preferred details of positive moment reinforcement in girders.
>
> - The specification of the minimum age of the precast girder when continuity is established is not required.
>
> - The requirements of AASHTO LRFD Articles 5.14.1.4.6, 5.14.1.4.7, and 5.14.1.4.8 shall apply.
>
> - The design of continuity diaphragms at interior supports may be based on the strength of the concrete in the girders when the ends of girders are directly opposite each other across a continuity diaphragm.

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TTY: (803) 737-3870

Sections 15.5.3.1 and 15.5.3.3 of the *Manual* shall be revised as indicated below:

a. Section 15.5.3.1 shall be replaced with the following:

   Tensile stress limits for fully prestressed concrete members shall conform to the requirements for "Other Than Segmentally Constructed Bridges" in LRFD Article 5.9.4. Projects located in Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Horry, and Jasper Counties shall be designed using the stress limits for severe corrosive conditions. Projects located in all other counties shall be designed using the stress limits for moderate corrosion conditions.

b. The last paragraph of Section 15.5.3.3 shall be replaced with the following:

   In analyzing stresses and/or determining the required length of debonding, stresses shall be limited to the values in LRFD Article 5.9.4. Projects located in Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Horry, and Jasper Counties shall be designed using the stress limits for severe corrosive conditions. Projects located in all other counties shall be designed using the stress limits for moderate corrosion conditions.

Please note these revisions in your copy of the *Manual.* The *Manual* will be updated at a later date to reflect these requirements.

E. S. Eargle
Preconstruction Support Engineer

cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers

File: PC/BWB

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0208

TO: RPG Structural Engineers
Structural Design Consultants

DATE: April 2, 2008

RE: Revised Bridge Title Sheets

Attached for your use are copies of revised bridge title sheets for both in-house and Consultant designed projects. Electronic copies of these sheets can be obtained from the *SCDOT Bridge Drawings and Details* at the Department's website.

The revised title sheets include the following changes:

- The signature blocks found on the previous in-house title sheet have been replaced by blocks for the initials of the reviewers. The list of reviewers has been revised to reflect Preconstruction's current organization.
- Blocks for the initials of Department reviewers have been added to the Consultant title sheet.
- An information block has been added to provide the mailing address for shop plan submittals. For Consultant-designed projects, the Consultant will provide contact information for the office that is responsible for review of the shop plans for the project.
- Additional information blocks have been provided outside the sheet borders. These additional information blocks are placed on the title sheets of "fast track" or other similar types of bridge projects where roadway approach plans are incorporated in the bridge plans.

These changes amend the requirements of Section 6.3.1 of the *SCDOT Bridge Design Manual.* The *Manual* will be updated at a later date to reflect the changes.

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
Attachments
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

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TTY: (803) 737-3870

Title.dgn

PCN	SHEET NO.	TOTAL SHEETS
XXXXX	XX	XX

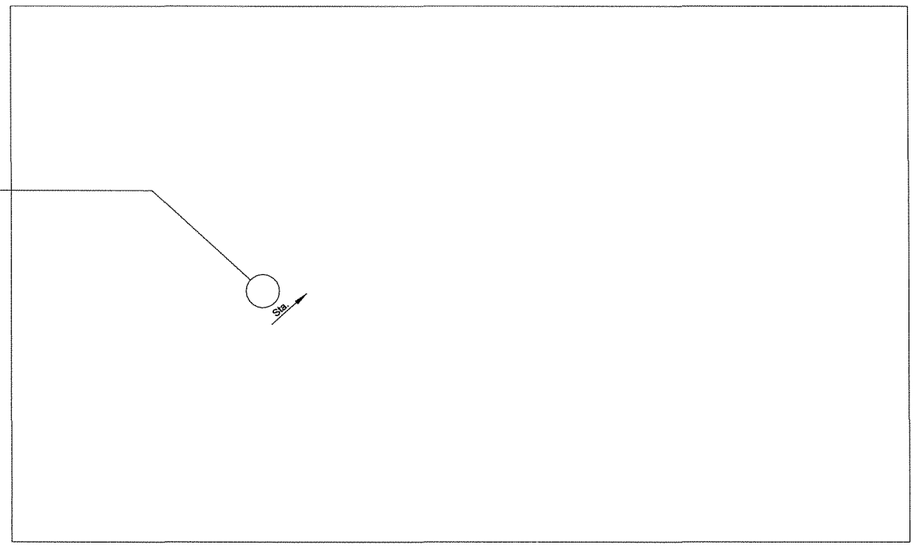
INDEX OF SHEETS

1. Title Sheet
2. Summary of Estimated Quantities
3. General Notes
4. General Details
5. Reinforcing Bending Details

South Carolina Department of Transportation

PROPOSED PLANS FOR COUNTY FILE NO. ROUTE REPLACE BRIDGE OVER

SITE LOCATION



LAYOUT

Submit Shop Plans to:

SCDOT
Preconstruction Support Engineer
Attn: Logistics Coordinator - Shop Plans
955 Park Street - Room 409
Columbia, SC 29201

Approximate Location of Bridge is

Latitude 00°- 00' - 00"
Longitude 00°- 00' - 00"

	FOR CONSTRUCTION INITIAL	FOR CONSTRUCTION DATE
RPG - HYDROLOGY		
RPG - STRUCTURES		
RPG - GEOTECHNICAL		
PRECONSTRUCTION SUPPORT - STRUCTURES		
RPG - DESIGN MANAGER		
RPG - PROGRAM MANAGER		

3 DAYS BEFORE DIGGING IN SOUTH CAROLINA

CALL 811

PALMETTO UTILITY PROTECTION SERVICES, INC. (PUPS)
ALL UTILITIES MAY NOT BE A MEMBER OF PUPS.

NET LENGTH OF ROADWAY	0.000 MILES
NET LENGTH OF BRIDGES	0.000 MILES
NET LENGTH OF PROJECT	0.000 MILES
LENGTH OF EXCEPTIONS	0.000 MILES
GROSS LENGTH OF PROJECT	0.000 MILES

NOTE: EXCEPT AS MAY OTHERWISE BE SPECIFIED ON THE PLANS OR IN THE SPECIAL PROVISIONS, ALL MATERIALS AND WORKMANSHIP ON THIS PROJECT SHALL CONFORM TO THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION (2007 EDITION) AND THE STANDARD DRAWINGS FOR ROAD CONSTRUCTION IN EFFECT AT THE TIME OF LETTING.

TRAFFIC DATA

0000 ADT 0000

0000 ADT 0000

TRUCKS 00 %

ENGINEER OF RECORD

FOR CONSTRUCTION : _____ _____ DATE

REVIEWED			
DR.	XXX	XXX	XX-XX
	BY	CHK	DATE

Nanney/A
Printed: Wednesday, April 02, 2008 11:50:35 AM

ADDITIONAL INFORMATION PROVIDED OUTSIDE THE IN-HOUSE TITLE SHEET BORDER

Note to Designer:

These information blocks are for use on "fast track" or other similar types of bridge projects where roadway approach plans are incorporated in the bridge plans.

NPDES PERMIT INFORMATION
NPDES Disturbed Area = _____ Acre(s)
Approximate Location of Roadway is Begin Latitude _____ Longitude _____ End Latitude _____ Longitude _____
Hydraulic and NPDES Design provided by: _____ Designs may be obtained from the SCDOT Regional Production Group

	FOR CONSTRUCTION	
	INITIAL	DATE
RPG - ROAD		
RPG - HYDROLOGY		
RPG - STRUCTURES		
RPG - GEOTECHNICAL		
PRECONSTRUCTION SUPPORT - ROAD		
PRECONSTRUCTION SUPPORT - STRUCTURES		
RPG - DESIGN MANAGER		
RPG - PROGRAM MANAGER		

TitleforConsultant.dgn

PCN	SHEET NO.	TOTAL SHEETS
XXXXX	XX	XX

INDEX OF SHEETS

1. Title Sheet
2. Summary of Estimated Quantities
3. General Notes
4. General Details
5. Reinforcing Bending Details

South Carolina Department of Transportation

PROPOSED PLANS FOR COUNTY FILE NO. ROUTE REPLACE BRIDGE OVER

Note to Designer:

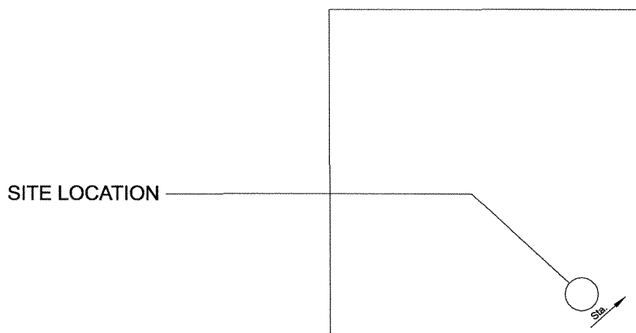
Consultant to provide contact information including mailing address and telephone number of office responsible for review of shop plans.

Submit Shop Plans to:

Insert Name of Consulting Firm
Insert Mailing Address

Telephone: (XXX) XXX-XXXX

SITE LOCATION



-N-

LAYOUT

Approximate Location of Bridge is

Latitude 00°- 00' - 00"
Longitude 00°- 00' - 00"

SCDOT REVIEW	FOR CONSTRUCTION INITIAL	FOR CONSTRUCTION DATE
PRECONSTRUCTION SUPPORT - ROAD		
PRECONSTRUCTION SUPPORT - STRUCTURES		
RPG - DESIGN MANAGER		
RPG - PROGRAM MANAGER		

THE INITIALS ABOVE DO NOT RELIEVE THE ENGINEER OF RECORD OF THE RESPONSIBILITY TO DESIGN THIS PROJECT IN ACCORDANCE WITH ALL APPLICABLE CRITERIA.

3 DAYS BEFORE DIGGING IN SOUTH CAROLINA

CALL 811

PALMETTO UTILITY PROTECTION SERVICES, INC. (PUPS)
ALL UTILITIES MAY NOT BE A MEMBER OF PUPS.

NET LENGTH OF ROADWAY	0.000	MILES
NET LENGTH OF BRIDGES	0.000	MILES
NET LENGTH OF PROJECT	0.000	MILES
LENGTH OF EXCEPTIONS	0.000	MILES
GROSS LENGTH OF PROJECT	0.000	MILES

NOTE: EXCEPT AS MAY OTHERWISE BE SPECIFIED ON THE PLANS OR IN THE SPECIAL PROVISIONS, ALL MATERIALS AND WORKMANSHIP ON THIS PROJECT SHALL CONFORM TO THE SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION (2007 EDITION) AND THE STANDARD DRAWINGS FOR ROAD CONSTRUCTION IN EFFECT AT THE TIME OF LETTING.

TRAFFIC DATA

0000 ADT 0000

0000 ADT 0000

TRUCKS 00 %

CONSULTING ENGINEERING FIRM

ENGINEER OF RECORD

FOR CONSTRUCTION : _____ _____ DATE

REVIEWED		
DR.	XXX	BY
	XXX	CHK
	XX-XX	DATE

NannerySA
Printed: Wednesday, April 02, 2008 11:53:08 AM

ADDITIONAL INFORMATION PROVIDED OUTSIDE THE CONSULTANT TITLE SHEET BORDER

Note to Designer:

This information block is for use on "fast track" or other similar types of bridge projects where roadway approach plans are incorporated in the bridge plans.

NPDES PERMIT INFORMATION

NPDES Disturbed

Area = _____ Acre(s)

Approximate Location of Roadway is

Begin

Latitude _____

Longitude _____

End

Latitude _____

Longitude _____

Hydraulic and NPDES Design provided by:

_____

Designs may be obtained from the SCDOT Regional Production Group

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0308

TO: RPG Structural Engineers
Structural Design Consultants

DATE: June 6, 2008

RE: Revised Prestressed Concrete Cored Slab Drawings

The Department's prestressed cored slab drawings have been revised. The revised drawings include the following changes:

- The ½-inch diameter transverse post-tensioning strands have been replaced with 1¼-inch diameter tie rods and the 2-inch diameter holes have been increased to 3 inches to accommodate the 1¼-inch diameter transverse tie rods.
- The dowel hole locations and the elastomeric bearing pad dimensions have been revised.
- A new drawing, Drawing 704-70, has been added that provides details for a 70-foot span.
- Details that are common to all of the spans have been removed from the individual span sheets and placed on a new drawing, Drawing 704-29.

Electronic copies of these drawings can be obtained from the *SCDOT Bridge Drawings and Details* at the Department's website.

When using the updated drawings, the designer should include the new detail sheets (Drawing 704-29) after the span sheet(s). The attached special provision shall be included in contracts containing these updated drawings. The designer must evaluate the design and revise the drawings when barrier parapet transitions or vertical railing walls are required. Due to the camber of the slab units, the designer must also evaluate the design and details of these spans to ensure the required finished grade profile can be maintained.

For previously completed plans that include the ½-inch diameter transverse post-tensioning strands, the designer should allow the Contractor the option of constructing the spans

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using the details for the 1¼-inch diameter tie rods. However, the Contractor shall not be allowed to substitute ½-inch diameter transverse post-tensioning strands for the 1¼-inch diameter tie rods that are detailed on the revised drawings.

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
Attachment
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

SPECIAL PROVISION FOR PRESTRESSED CONCRETE CORED SLABS

(XX) SECTION 704: PRESTRESSED CORED SLABS:
Subsection 704.4.6 is amended as follows:

Delete Paragraph 2 of Subsection 704.4.6.2 and replace it with the following:

"Provide holes and recesses at locations indicated in the Shop Plans for insertion of the 1¼ -inch diameter transverse tie rods.

Delete Subsection 704.4.6.5 and replace it with the following:

"704.4.6.5 Transverse Tie Rods

In each span, place 1¼-inch diameter transverse tie rods and tighten to a snug fit. After the 1¼-inch diameter transverse tie rods have been tightened in a span and before any equipment, material or barrier parapet is placed on the span, fill the shear keys, dowel holes, and tie rod recesses with the non-shrink grout as indicated on the Plans and allow curing for a minimum of 3 days. Ensure that the grout reaches a compressive strength of 5000 psi in 24 hours. Properly remove any foreign substance/materials including grease from the exposed portions of transverse tie rods before grouting the recesses.

With the approval of the RCE, material and equipment may be placed on the cored slab spans after the transverse tie rods have been tightened, the grout in shear keys has cured for 3 days minimum, and the grout has reached a compressive strength of 5000 psi."

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0408

TO: RPG Structural Engineers
Structural Design Consultants

DATE: June 16, 2008

RE: Adhesively Bonded Anchors and Dowels

Beginning with the September 2008 Letting, the Supplemental Specification for Adhesively Bonded Anchors and Dowels should be included in all Department Contracts where adhesive anchorages are specified or permitted. This specification contains requirements for the installation and testing of adhesive anchorages and is available at the Department's website.

The attached "Guidelines for Design of Adhesively Bonded Anchors and Dowels" should be followed when designing adhesive anchorages. The designer shall specify on the plans if field testing is required and, if field testing is required, the designer shall also specify the test load. For each adhesive anchor application that is specified or permitted, one of the following notes shall be included on the plans:

- For applications where field testing is required
  Provide and install anchorages in accordance with the requirements of the Supplemental Specification for Adhesively Bonded Anchors and Dowels. Use an adhesive bonding system that has a minimum bond strength of 1.5 ksi. Field test the anchorages, using a test load of ____ kips per anchor, in accordance with the requirements of the Supplemental Specification.
- For applications where field testing is not required
  Provide and install anchorages in accordance with the requirements of the Supplemental Specification for Adhesively Bonded Anchors and Dowels. Use an adhesive bonding system that has a minimum bond strength of 1.5 ksi. Field testing of the anchorages is not required.

See Section 3.0 of the attached Guidelines for applications where field testing should be required and for the method to determine the magnitude of the test load.

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
Attachment
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
Director of Traffic Engineering
FHWA Structural Engineer
Materials and Research Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

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GUIDELINES FOR
DESIGN OF ADHESIVELY BONDED ANCHORS AND DOWELS

1.0 Notation

A_e = effective cross sectional area of steel anchor (in^2)
A_{no} = effective area of a single anchorage in tension (in^2) See Figure 1.1.
A_n = effective area of a group of anchorages in tension (in^2) See Figure 1.1.
A_{vo} = effective area of a single anchorage in shear (in^2) See Figure 1.2.
A_v = effective area of a group of anchorages in shear (in^2) See Figure 1.2.
c = anchorage edge distance, measured from free edge to centerline of anchorage (in)
d = diameter of steel anchor (in)
f'_c = specified minimum 28-day compressive strength of concrete (ksi)
f_y = specified minimum yield strength of steel anchor (ksi)
h = concrete member thickness (in)
h_e = embedment depth of steel anchor (in)
N_c = nominal tensile resistance of anchorage as controlled by concrete embedment (kips)
N_n = nominal tensile resistance of anchorage (kips)
N_p = nominal tensile resistance of anchorage as controlled by pullout (kips)
N_s = nominal tensile resistance of anchorage as controlled by anchor steel strength (kips)
N_u = factored tensile load (kips)
s = anchorage spacing (in)
V_c = nominal shear resistance of anchorage as controlled by concrete embedment (kips)
V_n = nominal shear resistance of anchorage (kips)
V_s = nominal shear resistance of anchorage as controlled by anchor steel strength (kips)
V_u = factored shear load (kips)
T = specified minimum bond strength of adhesive (ksi)
ϕ_c = 0.85, resistance factor used for anchorage controlled by concrete embedment
ϕ_s = 0.90, resistance factor used for anchorage controlled by anchor steel strength
Ψ_e = modification factor for anchorage in tension having an edge distance less than 8d
Ψ_s = modification factor for a group of anchorages in tension having a spacing less than 16d
Ψ_v = modification factor for anchorages in shear

2.0 Design Requirements

2.1 General Requirements

a. Where practical, anchorage spacing, s, should be 16d or greater and anchorages should have an edge distance, c, greater than or equal to 8d. Anchorage spacing, s, shall not be less than 12d and anchorages shall have an edge distance, c, greater than or equal to 5d.

b. The minimum concrete member thickness, h, shall be greater than or equal to $2d + h_e$.

c. Adhesive anchorages should be designed for a ductile failure. A ductile failure may be assumed when the following embedment depths are used:
   - For Anchorages in Tension: An embedment depth, h_e, capable of achieving 125% of the specified minimum yield strength of the anchor, f_y
   - For Anchorages in Shear: An embedment depth, h_e, equal to 70% of the embedment depth required to achieve 125% of the specified minimum yield strength of the anchor, f_y

d. Adhesive anchorages shall not be used in overhead or upwardly inclined installations. See Figure 1.3.

e. Adhesive anchorages shall not be used in applications having predominately sustained tensile loads and lack of structural redundancy. Predominately sustained tensile loads are defined as loadings where the permanent component of the factored tensile load, N_u, exceeds 30% of the nominal tensile resistance, N_n.

f. Adhesive anchorages should not be used on prestressed concrete members.

2.2 Tensile Loading

Anchors loaded in tension shall have an embedment depth, h_e, greater than or equal to 8d.

Anchorages shall be designed such that:

$$\phi N_n \geq N_u$$

where:

ϕN_n = the lesser of ϕN_s or ϕN_p

The tensile resistance of the anchorage steel shall be taken as:

$$\phi N_s = \phi_s A_e f_y$$

The tensile resistance of the anchorage bond shall be taken as:

$$\phi N_p = \phi_c \Psi_e \Psi_s N_c$$

where:

$\Psi_e = 1.0$ when $c \geq 8d$
and
$\Psi_e = 0.70 + 0.30\ (c / 8d)$ when $8d > c \geq 5d$

$\Psi_s = 1.0$ when $s \geq 16d$
and
$\Psi_s = A_n / A_{no}$ when $16d > s \geq 12d$

$N_c = T\ \pi\ d\ h_e$

2.3 Shear Loading

Anchors loaded in shear shall have an embedment depth, h_e, greater than or equal to 6d.

Anchorages shall be designed such that:

$$\phi V_n \geq V_u$$

where:

ϕV_n = the lesser of ϕV_s or ϕV_c

The shear resistance of the anchorage steel shall be taken as:

$$\phi V_s = \phi_s\ 0.7\ A_e\ f_y$$

The shear resistance based on concrete strength shall be taken as:

$$\phi V_c = \phi_c\ \Psi_v\ 0.317\ \sqrt{d}\ \sqrt{f'_c}\ c^{1.5}$$

where:

$\Psi_v = 1.0$ when $s \geq 3c$ and $h \geq 1.5c$
and
$\Psi_v = A_v / A_{vo}$ when $s < 3c$ and/or $h < 1.5c$

2.4 Interaction of Tensile and Shear Loadings

For combinations of tensile and shear loadings, anchorages shall be designed such that:

$$(N_u / \phi N_n) + (V_u / \phi V_n) \leq 1.0$$

where:

ϕN_n = the lesser of ϕN_s or ϕN_p

ϕV_n = the lesser of ϕV_s or ϕV_c

3.0 Field Testing Requirements

3.1 Field Testing Applications

Field testing of adhesively bonded anchors and dowels should be required for the following applications:

- Anchor bolts used to attach metal railing posts to top of concrete rails or parapets
- Dowels used to attach cast-in-place wingwalls/headwalls/curtain walls to precast culverts
- Dowels used for bridge widening or staged construction between substructure units or bridge decks
- Anchor bolts for bearing replacements for rehabilitation work
- Attachments of guardrails to culverts
- Attachments of temporary concrete barrier to bridge decks

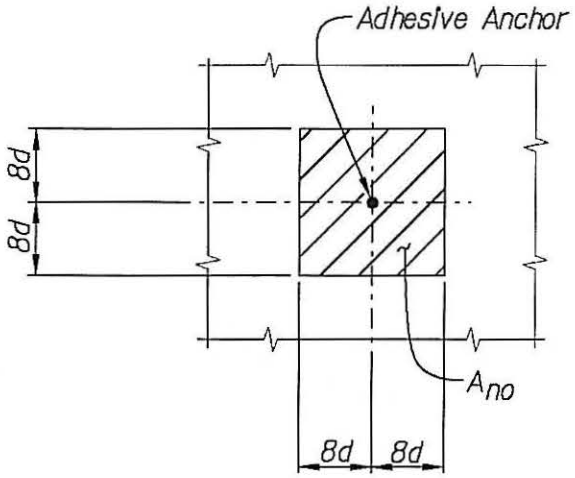
Field testing of adhesively bonded anchors and dowels should not be required for the following applications:

- Dowels used to attach sidewalks to bridge decks
- Dowels used for culvert extensions

For applications other than those listed above, the designer shall determine the need for field testing.

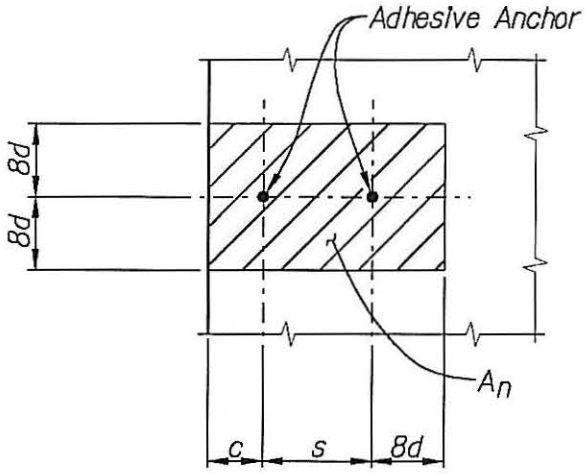
3.2 Field Test Loads

When field testing is required, the test load shall be specified on the Plans. The test load should be the lesser of 0.85 N_c or 0.9 A_e f_y.



PLAN

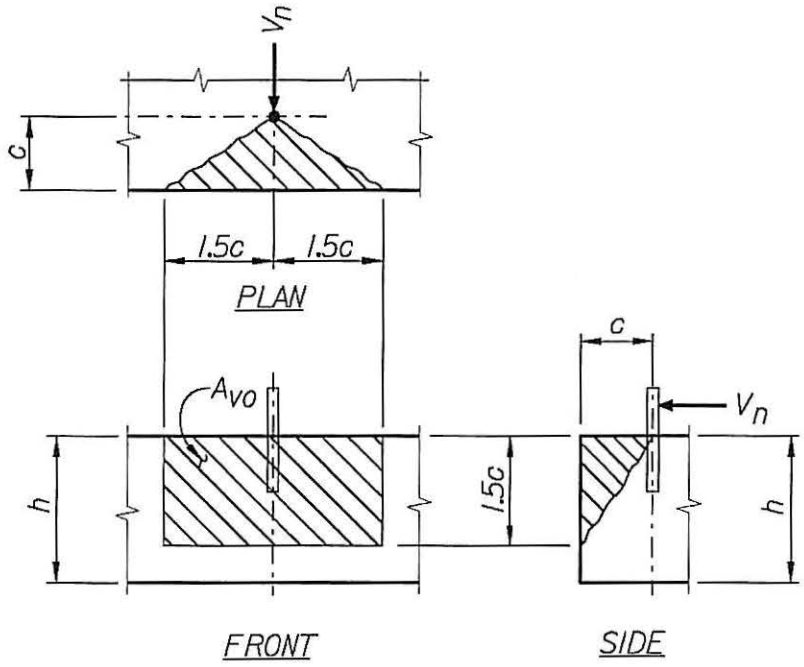
Showing Effective Tensile Area, A_{no}, When $c \geq 8d$ and $s \geq 16d$



PLAN

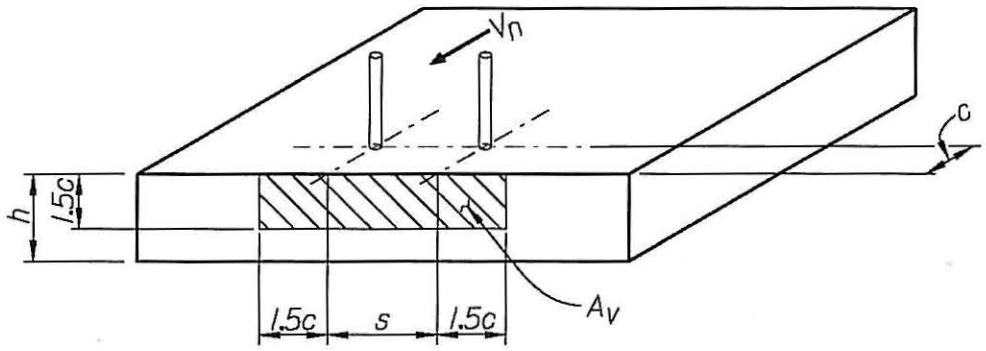
Showing Effective Tensile Area, A_n, When $5d \leq c < 8d$ and $12d \leq s < 16d$

FIGURE 1.1



DETAIL A

Showing Effective Shear Area, A_{VO}, When $s \geq 3c$



DETAIL B

Showing Effective Shear Area, A_V, When $s < 3c$

FIGURE 1.2

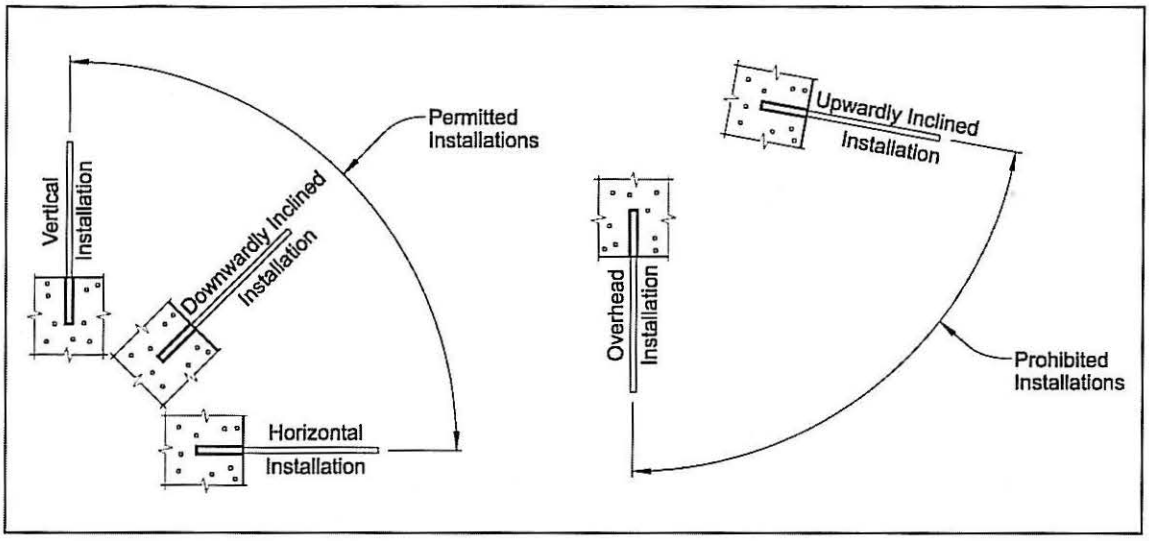

Permitted
Installations
Vertical
Installation
Downwardly Inclined
Installation
Horizontal
Installation
Upwardly Inclined
Installation
Overhead
Installation
Prohibited
Installations

FIGURE 1.3

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0508

TO: RPG Structural Engineers
Design Consultants

DATE: August 28, 2008

RE: *SCDOT Geotechnical Design Manual* and Updated *SCDOT Seismic Design Specifications for Highway Bridges*

Effective October 1, 2008, designs for all new South Carolina Department of Transportation (SCDOT) projects shall comply with the requirements of the *SCDOT Seismic Design Specifications for Highway Bridges*, Version 2.0 and the first 12 Chapters of the *SCDOT Geotechnical Design Manual*, Version 1.0. For projects currently in the preliminary design phase (i.e., when the subsurface exploration has not been performed), the Department's Project Manager may also elect to require the use of these documents.

These documents may be purchased from the Department's Engineering Publications Office at (803) 737-4533 or at engrpubsales@dot.state.sc.us. The cost of the seismic specifications is $25.00 per copy and the cost of Chapters 1 through 12 of the geotechnical manual is $65.00 per copy.

Drawings 700-03 and 700-04 of the *SCDOT Bridge Drawings and Details* have been revised to reference the updated seismic specifications. Section 11.2.2 of the *SCDOT Bridge Design Manual* shall be revised as follows:

> Where conflicts are observed in those publications and documents used by SCDOT, the following hierarchy of priority shall be used to determine the appropriate application:
>
> 1. Bridge Design Memorandums issued after May 2006,
> 2. *SCDOT Bridge Design Manual*,
> 3. *SCDOT Seismic Design Specifications for Highway Bridges*,
> 4. *SCDOT Geotechnical Design Manual*,
> 5. *LRFD Bridge Design Specifications*, and
> 6. all other publications.

As the need arises, Bridge Design Memorandums will be issued to supplement or revise the requirements of the referenced documents.

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
Director of Traffic Engineering
FHWA Structural Engineer
Materials and Research Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

South Carolina Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0608

TO: RPG Structural Engineers
Design Consultants

DATE: October 14, 2008

RE: *SCDOT Seismic Design Specifications for Highway Bridges*, Version 2.0
Corrections to Equations 9-1 and 9-2

After publication of the *SCDOT Seismic Design Specifications for Highway Bridges*, Version 2.0, errors were noted in Equations 9-1 and 9-2 on page 9-1. The correct equations are shown below:

Equation 9-1

$$N = \left(4 + \Delta_{ot} + 0.2H_s\right)\left(1 + \frac{S^2}{4000}\right) \geq 12"$$

Equation 9-2

$$N = \left(4 + \Delta_{ot} + 1.65\Delta_{eq}\right)\left(1 + \frac{S^2}{4000}\right) \geq 14"$$

Attached is a revised copy of page 9-1 that can be used to update your copy of the Specifications.

Original Signed by E. S. Eargle on October 14, 2008

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
Attachment
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
File: PC/BWB

Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers

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SECTION 9 – MISCELLANEOUS DETAILING

9.1 MINIMUM SUPPORT LENGTH

The minimum support length at expansion bents and free standing or non-integral end bents shall accommodate the differential seismic displacements between the substructure and the superstructure. The minimum support length capacity shall meet or exceed the minimum support length demand of the superstructure. Support length at fixed bents (superstructure continuous over the bents) need not be computed. The minimum support length (see Figure 9.1) is computed using Equation 9-1 or 9-2.

9.1.1 SDC A and Single Span Bridges

$$N = \left(4 + \Delta_{ot} + 0.2H_s\right)\left(1 + \frac{S^2}{4000}\right) \geq 12" \qquad (9\text{-}1)$$

Where:

N Minimum support length (in)

Δ_{ot} Movement attributed to prestress shortening creep, shrinkage and thermal expansion or contraction to be considered no less than one inch per 100 feet of bridge superstructure length between expansion joints (in)

H_s The largest column height in the most flexible frame adjacent to the expansion joint under consideration. The average height from the top of column to top of footing for pile bents, or to the point of fixity of drilled shaft or pile foundations. For single spans seated on abutments, the term is taken as the abutment height (ft)

S The skew angle of the bridge substructure measured from a line normal to the span (degrees)

9.1.2 SDC B and C Bridges

$$N = \left(4 + \Delta_{ot} + 1.65\Delta_{eq}\right)\left(1 + \frac{S^2}{4000}\right) \geq 14" \qquad (9\text{-}2)$$

Where:

N Minimum support length (in)

Δ_{eq} Seismic displacement demand of the long period frame on one side of the expansion joint (in)

Δ_{ot} Movement attributed to prestress shortening creep, shrinkage and thermal expansion or contraction to be considered no less than one inch per 100 feet of bridge superstructure length between expansion joints (in)

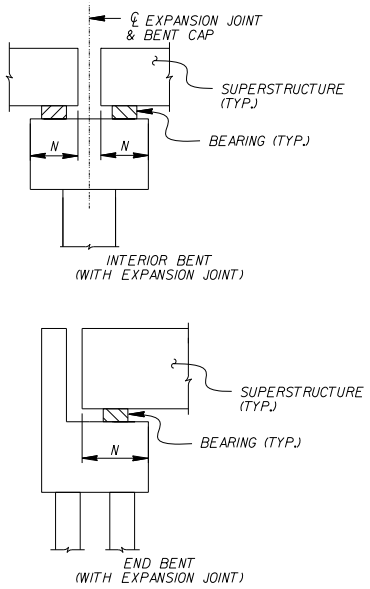

Figure 9.1 Dimensions for Support Length Requirement

9.1.3 SDC D Bridges

The minimum support length for SDC D bridges shall satisfy Equation 9-2 except the lower boundary is 24".

9.2 LONGITUDINAL AND TRANSVERSE CONNECTIONS

Transverse seismic forces are transmitted to the substructure through dowel bars, anchor bolts and/or shear keys. Typically, these components are designed to behave elastically so that the combination of anchor bolts, dowel bars and/or shear keys are designed to satisfy Equation 9-3 in both the longitudinal and transverse directions for bridges of any SDC.

$$V_u \leq \phi_v\left(V_{sk} + V_{ab} + V_{bw}\right) \qquad (9\text{-}3)$$

Where:

V_u Smaller of elastic shear force or the overstrength plastic hinge shear force (k)

V_{sk} Shear strength of the shear key (k)

V_{ab} Shear strength of anchor bolts (k)

V_{bw} Shear strength of the backwall (k)

ϕ_v Shear strength reduction factor (dimensionless)

South Carolina Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0109

TO: RPG Structural Engineers
Design Consultants

DATE: January 27, 2009

RE: Exceptions to SCDOT Structural Design Criteria

This memorandum updates the Department's requirements for obtaining a design exception to structural design criteria. A Structural Design Exception Request must be completed when a designer proposes a design element that does not meet the criteria or policies of the *SCDOT Bridge Design Manual*, the *SCDOT Seismic Design Specifications for Highway Bridges*, the *SCDOT Geotechnical Design Manual*, or the *AASHTO LRFD Bridge Design Specifications*.

Section 11.2.3 of the *SCDOT Bridge Design Manual* shall be deleted and replaced with the following:

11.2.3 Structural Design Exceptions

This Section discusses the Department's procedures for identifying, justifying, and processing exceptions to the structural design criteria in the *SCDOT Bridge Design Manual*, the *SCDOT Seismic Design Specifications for Highway Bridges*, the *SCDOT Geotechnical Design Manual*, and the *AASHTO LRFD Bridge Design Specifications*.

11.2.3.1 Department Intent

The general intent of the South Carolina Department of Transportation is that all of its structural design criteria shall be met. However, recognizing that this may not always be practical, the Department has established a process to evaluate and approve exceptions to its structural design criteria.

11.2.3.2 Procedures

Structural Design Exception Requests are only required where criteria or policies in the *SCDOT Bridge Design Manual*, the *SCDOT Seismic Design Specifications for Highway Bridges*, the *SCDOT Geotechnical Design Manual*, or the *AASHTO LRFD Bridge Design Specifications* are presented in one of the following contexts (or the like):

- "shall,"
- "mandatory," or
- "required."

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When a design exception is identified, the designer will first seek to eliminate the exception to design. If the design exception cannot be eliminated, the Regional Production Group Design Manager (for In-House Designed Projects) or the Engineer of Record (for Consultant Designed Projects) will prepare a Structural Design Exception Request and submit it to the Program/Project Manager. The request shall include the attached request form and any supporting data needed for justification. The justification may include items such as site constraints, construction costs, construction considerations, environmental impacts, and/or right-of-way impacts.

The Program/Project Manager will present the Structural Design Exception Request to the Regional Production Engineer. If the Regional Production Engineer recommends approval, the request will be forwarded to the Structural Design Support Engineer. The Structural Design Support Engineer will perform an objective review, from a statewide perspective, and may attach comments to the request. The request will then be returned to the Regional Production Engineer, who will submit the request to the Director of Preconstruction for consideration of approval. For projects where the Federal Highway Administration has full oversight, the Director of Preconstruction will submit approved requests to the Federal Highway Administration for concurrence.

At many locations in the *SCDOT Bridge Design Manual*, the text specifically states that approvals are required by the State Bridge Design Engineer. For these instances, a Structural Design Exception Request is not required. Because the position of State Bridge Design Engineer does not exist in the current organization of Preconstruction, this type of approval must be obtained, in writing, from the appropriate Regional Production Engineer. To ensure consistency is maintained statewide, the Regional Production Groups should coordinate with the Preconstruction Support Group when considering these approval requests and copies of approvals should be forwarded to the Preconstruction Support Engineer.

Original Signed by E. S. Eargle on January 27, 2009

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
Attachment
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

South Carolina
Department of Transportation

STRUCTURAL DESIGN EXCEPTION REQUEST

Submitted to: _____
Program/Project Manager

Submitted by: _____
RPG Design Manager or Engineer of Record

Date: _____

PROJECT INFORMATION

PCN: _____
County: _____
Route: _____
Crossing: _____
Project Type (Replacement, Rehabilitation, etc.): _____
Traffic Data: _____
Project Cost Estimate: _____

BASIS OF DESIGN EXCEPTION

- ☐ Request for Approval of Design Exception to *SCDOT Bridge Design Manual*
- ☐ Request for Approval of Design Exception to *SCDOT Seismic Design Specifications for Highway Bridges*
- ☐ Request for Approval of Design Exception to *SCDOT Geotechnical Design Manual*
- ☐ Request for Approval of Design Exception to *AASHTO LRFD Bridge Design Specifications*

*DESCRIPTION OF DESIGN EXCEPTION

_____
_____
_____
_____
_____

*JUSTIFICATION FOR DESIGN EXCEPTION

_____
_____
_____
_____
_____

***DESCRIPTION OF NECESSARY ACTIONS AND ASSOCIATED COSTS TO ELIMINATE DESIGN EXCEPTION**

_____
_____
_____
_____
_____

***DESCRIPTION OF HOW DESIGN EXCEPTION MAY IMPACT FUTURE CONSTRUCTION**

_____
_____
_____
_____
_____

*Attach additional pages if needed.

RECOMMENDED:

_____ Date: _____

Regional Production Engineer

REVIEWED: ☐ No Comments ☐ Comments Attached

_____ Date: _____

Structural Design Support Engineer

APPROVED:

_____ Date: _____

Director of Preconstruction

FHWA CONCURRENCE: (For Full Oversight Projects)

_____ Date: _____

Federal Highway Administration

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0209

TO: RPG Structural Engineers
Design Consultants

DATE: February 20, 2009

RE: Steel H-Pile Anchorage Detail
Figure 19.2-2 of the *SCDOT Bridge Design Manual*

Figure 19.2-2 of the *SCDOT Bridge Design Manual* shall be deleted and replaced with the attached detail. The revised detail allows the Contractor the option to either drill or flame cut the anchorage holes. To provide a construction tolerance for the holes, the designer must specify a minimum and maximum hole size.

A minimum of two #6 (#19) bars shall be used for the anchorage. The maximum hole size should be limited to two times the diameter of the bar and the minimum hole size should be ¼" larger than the bar diameter. The reinforcing bar must be detailed with sufficient length to fully develop the bar beyond the bottom mat of the footing or bent cap reinforcement.

Original Signed by E. S. Eargle on February 20, 2009

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
Attachment
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

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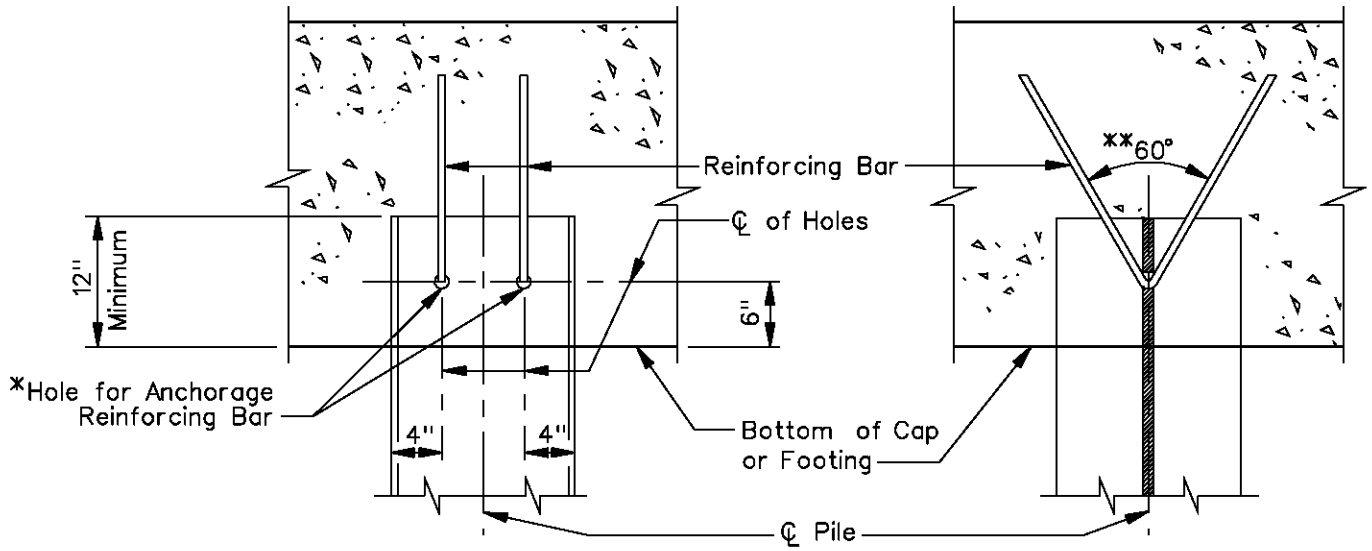

Note: Drill or flame cut the holes. Grind area around flame cut holes to remove burrs. Tie or wedge tightly the reinforcing bar against the top of the hole.

Steel H-Pile Anchorage Detail

* Designer to specify a minimum and maximum allowable hole diameter. The minimum diameter should be 1/4" larger than the reinforcing bar diameter and the maximum diameter should be two times the bar diameter.

** Preferred angle is 60° - If necessary, Designer may adjust angle to allow for development length of the reinforcing bar.

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0309

TO: RPG Structural Engineers
Design Consultants

DATE: July 16, 2009

RE: Guardrail-To-Bridge-Rail Transitions
Section 17.6.1.3 of the *SCDOT Bridge Design Manual*

Section 17.6.1.3 of the *SCDOT Bridge Design Manual* shall be deleted and replaced with the following:

17.6.1.3 Guardrail-To-Bridge-Rail Transitions

The roadway designer is responsible for specifying the guardrail-to-bridge-rail transition for the approaching roadway. However, site conditions may present problems for the necessary transition. Therefore, the bridge designer should coordinate with the roadway designer to ensure compatibility between the guardrail-to-bridge-rail transition and the site.

The bridge designer shall review the proposed guardrail-to-bridge-rail transition to determine if any conflicts exist between bridge components (such as end bent caps or sleeper slabs) and the guardrail post installations. If a conflict is found, the bridge designer shall first attempt to revise the details of the bridge component to permit the installation of driven guardrail posts in accordance with the *SCDOT Standard Drawings*. If necessary, the bridge designer may specify additional guardrail offset blocks. Two offset blocks are permitted at any post location and a third offset block may be used at one post only for each guardrail-to-bridge-rail transition.

If the conflict cannot be removed, the bridge designer shall design and detail a method for attaching the guardrail post to the bridge component and include the attachment details in the bridge plans.

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In cases where guardrail post attachments or additional guardrail offset blocks are necessary, the bridge designer must coordinate with the roadway designer to ensure that the roadway plans include information describing the installation requirements. For installations requiring additional offset blocks, the roadway designer must determine if additional length guardrail posts are needed. The plans should contain a note instructing the Contractor to include all costs for additional guardrail offset blocks, additional length posts, and/or guardrail post attachments in the unit price bid for Thrie Beam Guardrail Bridge Connector.

Original Signed by E. S. Eargle on July 16, 2009

E. S. Eargle
Preconstruction Support Engineer

ESE:bwb
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
RPG Road Design Leaders
File: PC/BWB

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0409

TO: RPG Structural Engineers
Design Consultants

DATE: November 30, 2009

RE: *SCDOT Americans with Disabilities Act Transition Plan*

Section 11.4 of the *SCDOT Bridge Design Manual* shall be amended to include the following:

11.4.8 ***SCDOT Americans with Disabilities Act Transition Plan***

The *SCDOT Americans with Disabilities Act Transition Plan* sets forth the steps necessary to complete physical and other modifications of SCDOT facilities and programs for which SCDOT is responsible in order to achieve the accessibility required by Title II of the Americans with Disabilities Act of 1990. All plans for new construction, alterations, and encroachments shall be developed to assure compliance with applicable provisions of the *SCDOT Americans with Disabilities Act Transition Plan.*

The *SCDOT Americans with Disabilities Act Transition Plan* is available at the SCDOT website.

Original Signed by E. S. Eargle on November 30, 2009

E. S. Eargle
Preconstruction Support Engineer

ESE:afg
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

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South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0509

TO: RPG Structural Engineers
Design Consultants

DATE: November 30, 2009

RE: Section 17.6.1.5 of the *SCDOT Bridge Design Manual*

Item 2 of Section 17.6.1.5 of the *SCDOT Bridge Design Manual* shall be deleted and replaced with the following:

2. V ≥ 50 mph. Place the 32-in concrete bridge barrier parapet between pedestrians and traffic; i.e., between the roadway portion of the bridge deck and the sidewalk. The 32-in concrete barrier must have a metal hand rail on top of the barrier to reach the required 42-in height for a pedestrian rail. A 42-in pedestrian rail is then used at the outside edge of the sidewalk. The sidewalk portion shall be detailed with a cross slope no greater than 2 percent as shown in Figure 12.6-7.

Original Signed by E. S. Eargle on November 30, 2009

E. S. Eargle
Preconstruction Support Engineer

ESE:afg
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

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South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0110

TO: RPG Structural Engineers
Design Consultants

DATE: January 15, 2010

RE: Section 11.3.9 of the *SCDOT Bridge Design Manual*

Section 11.3.9 of the *SCDOT Bridge Design Manual* shall be deleted and replaced with the following:

11.3.9 *LRFD Guide Specifications for the Design of Pedestrian Bridges*

11.3.9.1 Description

The AASHTO *LRFD Guide Specifications for the Design of Pedestrian Bridges* applies to bridges intended to carry primarily pedestrian traffic and/or bicycle traffic. This document provides guidance on the design and construction of pedestrian bridges in addition to that available in the *AASHTO LRFD Bridge Design Specifications*.

11.3.9.2 Department Application

The AASHTO *LRFD Guide Specifications for the Design of Pedestrian Bridges* shall be used for the design of pedestrian bridges in conjunction with the *AASHTO LRFD Bridge Design Specifications*.

Original Signed by E. S. Eargle on January 15, 2010

E. S. Eargle
Preconstruction Support Engineer

ESE:afg
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
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South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0210

TO: RPG Structural Engineers
Design Consultants

DATE: June 1, 2010

RE: *SCDOT Geotechnical Design Manual* – Version 1.1

Effective July 1, 2010, designs for all new South Carolina Department of Transportation (SCDOT) projects shall comply with the requirements of the *SCDOT Geotechnical Design Manual*, Version 1.1. Version 1.1 is comprised of the August 2008, Version 1.0 Edition, and the June 2010 Chapters 13 through 26 and Appendices B through G, which are joined together to form the complete *SCDOT Geotechnical Design Manual*. For projects currently in the preliminary design phase (i.e., when the subsurface exploration has not been performed), the Department's Project Manager may also elect to require the use of Version 1.1.

These documents may be purchased from the Department's Engineering Publications Office at (803) 737-4533 or at engrpubsales@dot.state.sc.us. The Manual will also be available on the SCDOT website.

As the need arises, Bridge Design Memorandums will be issued to supplement or revise the requirements of the Manual.

Original Signed by E. S. Eargle on June 1, 2010

E. S. Eargle
Preconstruction Support Engineer

ESE:afg
cc: Bridge Construction Engineer
Bridge Maintenance Engineer
Director of Traffic Engineering
FHWA Structural Engineer
Materials and Research Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

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South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0310

TO: RPG Structural Engineers
Design Consultants

DATE: July 22, 2010

RE: *SCDOT Geotechnical Design Manual*, Version 1.1
Revisions to Chapter 9, Chapter 16, and Appendix A

Tables 9-1, 9-2, 9-6, 9-7, 9-9, and 9-10 of the *SCDOT Geotechnical Design Manual* shall be deleted and replaced with the following tables:

Table 9-1, Resistance Factors for Shallow Foundations

Performance Limit		Limit States		
		Strength	Service	Extreme Event
Soil Bearing Resistance (Soil)	OC= I, II, III; ROC = I	0.40	N/A	0.60
	ROC = II or III	0.45		0.65
Soil Bearing Resistance (Rock)	OC= I, II, III; ROC = I	0.40	N/A	0.60
	ROC = II or III	0.45		0.65
Sliding Frictional Resistance (Cast-in-place Concrete on Sand)	OC= I, II, III; ROC = I	0.70	N/A	0.90
	ROC = II or III	0.80		0.95
Sliding Frictional Resistance (Cast-in-place Concrete on Clay)	OC= I, II, III; ROC = I	0.75	N/A	0.90
	ROC = II or III	0.85		0.95
Sliding Frictional Resistance (Precast Concrete on Sand)	OC= I, II, III; ROC = I	0.80	N/A	0.95
	ROC = II or III	0.90		1.00
Sliding Soil on Soil	OC= I, II, III; ROC = I	0.80	N/A	0.95
	ROC = II or III	0.90		1.00
Sliding Passive Resistance (Soil)	OC= I, II, III; ROC = I	0.40	N/A	0.55
	ROC = II or III	0.50		0.65
Lateral Displacement		N/A	1.00	1.00
Vertical Settlement		N/A	1.00	1.00

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Table 9-2, Geotechnical Resistance Factors for Driven Piles

Analysis and Method of Determination	Limit States			
	Strength		Service	Extreme Event
	Redundant	Non-Redundant		
Nominal Resistance Single Pile in Axial Compression with Wave Equation [1] (Soil)	0.40	0.30	N/A	1.00
Nominal Resistance Single Pile in Axial Compression with Wave Equation [1] (IGM and Rock)	0.50	0.40	N/A	1.00
Nominal Resistance Single Pile in Axial Compression with Dynamic Testing (PDA) and calibrated Wave Equation [2]	0.65	0.55	N/A	1.00
Nominal Resistance Single Pile in Axial Compression with Static Load Testing. Dynamic Monitoring (PDA) of test pile installation and calibrated Wave Equation [2,3].	See Table 9-4		N/A	1.00
Nominal Resistance Single Pile in Axial Compression with Statnamic Load Testing For Friction Piles. Dynamic Monitoring (PDA) of test pile installation and calibrated Wave Equation [2]	0.65	0.55	N/A	1.00
Nominal Resistance Single Pile in Axial Compression with Statnamic Load Testing For End Bearing Piles in Rock, IGM, or Very Dense Sand. Dynamic Monitoring (PDA) of test pile installation and calibrated Wave Equation [2].	0.70	0.55	N/A	1.00
Pile Group Block Failure (Clay)	0.60	N/A	N/A	1.00
Nominal Resistance Single Pile in Axial Uplift Load with No Verification	0.35	0.25	N/A	0.80
Nominal Resistance Single Pile in Axial Uplift Load with Static Load Testing	0.60	0.50	N/A	0.80
Group Uplift Resistance	0.50	N/A	N/A	N/A
Single or Group Pile Lateral Load – Geotechnical Analysis	1.00	1.00	1.00	1.00
Single or Group Pile Vertical Settlement	N/A	N/A	1.00	1.00
Pile Drivability – Geotechnical Analysis	1.00	1.00	N/A	N/A

[1] Applies only to factored loads less than or equal to 600 kips.
[2] See Table 9-3 for frequency of dynamic testing required.
[3] See Table 9-4 for number of static load testing required.

Table 9-6, Resistance Factors for Rigid Gravity Retaining Walls

Performance Limit		Limit States		
		Strength	Service	Extreme Event
Soil Bearing Resistance (Soil)	ROC = I, II	0.45	N/A	0.60
	ROC = III	0.45	N/A	0.60
Soil Bearing Resistance (Rock)		0.45	N/A	0.60
Sliding Frictional Resistance (Cast-in-place Concrete on Sand)	ROC = I, II	0.70	N/A	0.90
	ROC = III	0.80		0.95
Sliding Frictional Resistance (Cast-in-place Concrete on Clay)	ROC = I, II	0.75	N/A	0.90
	ROC = III	0.85		0.95
Sliding Frictional Resistance (Precast Concrete on Sand)	ROC = I, II	0.80	N/A	0.95
	ROC = III	0.90		1.00
Sliding Soil on Soil	ROC = I, II	0.80	N/A	0.95
	ROC = III	0.90		1.00
Lateral Displacement		N/A	1.00	1.00
Vertical Settlement		N/A	1.00	1.00
Global Stability Fill Walls	ROC= I, II	N/A	0.65	0.90 (1)
	ROC = III		0.75	1.00 (1)
Global Stability Cut Walls	ROC= I, II	N/A	0.60	0.90 (1)
	ROC = III		0.70	1.00 (1)

(1) Global stability analyses for Extreme Event I limit state that have resistance factors greater than specified require a displacement analysis to determine if it meets the performance limits presented in Chapter 10.

Table 9-7, Resistance Factors for Flexible Gravity Retaining Walls

Performance Limit		Limit States		
		Strength	Service	Extreme Event
Soil Bearing Resistance		0.65	N/A	1.00
Sliding Frictional Resistance		1.00	N/A	1.00
Lateral Displacement		N/A	1.00	1.00
Vertical Settlement		N/A	1.00	1.00
Global Stability Fill Walls	ROC= I, II	N/A	0.65	0.90 (1)
	ROC = III		0.75	1.00 (1)
Global Stability Cut Walls	ROC= I, II	N/A	0.60	0.90 (1)
	ROC = III		0.70	1.00 (1)

(1) Global stability analyses for Extreme Event I limit state that have resistance factors greater than specified require a displacement analysis to determine if it meets the performance limits presented in Chapter 10.

Table 9-9, Resistance Factors for Embankments (Fill / Cut Section)

Performance Limit		Limit States		
		Strength	Service	Extreme Event
Lateral Displacement		N/A	1.00	1.00
Vertical Settlement		N/A	1.00	1.00
Global Stability Embankment (Fill)	ROC= I, II	N/A	0.65	0.90 (1)
	ROC = III		0.75	1.00 (1)
Global Stability Cut Section	ROC= I, II	N/A	0.60	0.90 (1)
	ROC = III		0.70	1.00 (1)

(1) Global stability analyses for Extreme Event I limit state that have resistance factors greater than specified require a displacement analysis to determine if it meets the performance limits presented in Chapter 10.

Table 9-10, Resistance Factors for Reinforced Soils

Performance Limit		Limit States		
		Strength	Service	Extreme Event
Tensile Resistance of Metallic Reinforcement and Connectors (1)	Strip Reinforcement	0.75	N/A	1.00
	Grid Reinforcement (2)	0.65		0.85
Tensile Resistance of Geosynthetic Reinforcement And Connectors		0.90	N/A	1.20
Pullout Resistance of Tensile Reinforcement		0.90	N/A	1.20

(1) Apply to gross cross-section less sacrificial area. For sections with holes, reduce the gross area and apply to net section less sacrificial area.

(2) Applies to grid reinforcements connected to a rigid facing element (concrete panel or block). For grid reinforcements connected to a flexible facing mat or which are continuous with the facing mat, use the resistance factor for strip reinforcements.

The sixth paragraph of Section16.8 of the *Manual* (Lateral Capacity) shall be deleted and replaced with the following:

> Lateral designs for determining performance (deflections) are governed by the Service Limit State. The Strength Limit State is used in the determination of the lateral stability (critical depth) of the deep foundation. For group loadings using the P-y method of analysis, P-multipliers should be used in accordance with *AASHTO LRFD Bridge Design Specifications* Article 10.7 – Driven Piles.

In Appendix A of the *Manual*, Forms GDF 001 (Bridge Load Data Sheet), GDF 002 (Consultant Seismic Information Request), and GDF 003 (Consultant Geotechnical Seismic Response) shall be deleted and replaced with the attached forms dated July 22, 2010.

Please note these revisions in your copy of the *Manual*.

Original Signed by Barry W. Bowers on July 22, 2010 for
Preconstruction Support

BWB:afg
Attachments
ec: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

Bridge Load Data Sheet

PROJECT INFORMATION					
File No.		**PCN:**			
County:		**Route:**			
Description:					
Loads Provided By:		**Date Loads Provided:**			
Bridge Type:					
No. Spans /Lengths:		**Width / No. Lanes:**			
Edition of AASHTO LRFD Bridge Design Specifications:					
Edition of SCDOT Seismic Design Specifications for Highway Bridges:					
Bridge Operational Classification (OC):		**Site Class:**			
Seismic Design Category (SDC):		**Scour Report Attached**			
Proposed Foundations (foundation type, size, and number per bent)	**End Bent**				
	Interior Bent				
Location/Elev. of Applied Loads:	**End Bent:**		**Int. Bent:**		
Location/Elev. Est. Point of Fixity:	**End Bent:**		**Int. Bent:**		

Bridge Load Data Sheet

	Limit State	Strength			Service		
	Load Cases:	Case 1FL ($P=P_{max}$)	Case 2FL ($V=V_{max}$)	Case 3FL ($M=M_{max}$)	Case 1SL ($P=P_{max}$)	Case 2SL ($V=V_{max}$)	Case 3SL ($M=M_{max}$)
End Bent - Longitudinal	P (kips) =						
	V (kips) =						
	M (ft-kip) =						
End Bent - Transverse	P (kips) =						
	V (kips) =						
	M (ft-kip) =						
Interior Bent - Longitudinal	P (kips) =						
	V (kips) =						
	M (ft-kip) =						
Interior Bent - Transverse	P (kips) =						
	V (kips) =						
	M (ft-kip) =						

	Limit State	Extreme Event I			Extreme Event II[a]			Extreme Event II[b]		
	Load Cases:	Case 1EL ($P=P_{max}$)	Case 2EL ($V=V_{max}$)	Case 3EL ($M=M_{max}$)	Case 1EEL ($P=P_{max}$)	Case 2EEL ($V=V_{max}$)	Case 3EEL ($M=M_{max}$)	Case 1EEL ($P=P_{max}$)	Case 2EEL ($V=V_{max}$)	Case 3EEL ($M=M_{max}$)
End Bent - Longitudinal	P (kips) =									
	V (kips) =									
	M (ft-kip) =									
End Bent - Transverse	P (kips) =									
	V (kips) =									
	M (ft-kip) =									
Interior Bent - Longitudinal	P (kips) =									
	V (kips) =									
	M (ft-kip) =									
Interior Bent - Transverse	P (kips) =									
	V (kips) =									
	M (ft-kip) =									

Notes:

P – Axial; V – Shear; M – Moment; [a] – Check Flood w/o collision loads; [b] – Collision loads w/o check flood

Consultant Seismic Information Request

PROJECT INFORMATION			
File No.			**PCN:**
County:	**RPG[1]:**		**Route:**
Description:			
Latitude (4 decimals): .			**Longitude (4 decimals):** .

SEISMIC REQUEST

The SCDOT Geotechnical Design Manual and Seismic Design Specifications for Highway Bridges, latest editions, provide detailed seismic design requirements for transportation structures. The RPG Geotechnical Design Section (GDS) will be generating seismic design information from, *SCENARIO_PC*, the seismic analysis software. The consultant is encouraged to review the software documentation, *Information on Analysis Software*, for assistance in completing this form. The RPG GDS will be providing the pseudo-spectral acceleration (PSA) oscillator response for frequencies 0.5, 1.0, 2.0, 3.3, 5.0, 6.7 and 13 Hz, for 5% critical damping and peak horizontal ground acceleration (PGA) at either the **B-C Boundary** (Geologically Realistic) or **Hard Rock** Outcrop for specific project locations within South Carolina. The Geologically Realistic option is for sites in the Coastal Plain with sediment thickness greater than 100 feet to firm sediment (V_s=2,500 feet per second (ft/s) or NEHRP B-C Boundary). Geologically Realistic conditions can also be encountered outside of the Coastal Plain where the sediment thickness is 100 feet or less above the basement rock and the V_s = 8,000 ft/s. The Hard Rock Outcrop option is for an outcrop of hard rock ($V_s \geq$ 11,500 ft/s). The Preconstruction Support – Geotechnical Design Section (PCS/GDS) has developed a map to assist in determining the site condition. South Carolina has been divided in two zones, Zone I – Physiographic Units Outside of the Coastal Plain and Zone II – Physiographic Units of the Coastal Plain. This information can be provided for the Safety Evaluation Earthquake (SEE) 3% probability of exceedance for 75-year exposure periods or for the Functional Evaluation Earthquake (FEE) 15% probability of exceedance for 75-year exposure periods. The consultant is reminded that all embankment structures are required to be designed for both the SEE and FEE. The consultant will use this information in developing the Acceleration Design Response Spectrum (ADRS) in accordance with the SCDOT Geotechnical Design Manual and Seismic Design Specifications for Highway Bridges. The RPG GDS can also provide the Time Series for use in performing a Site-Specific Response Analysis.

STRUCTURE SEISMIC INFORMATION

Bridge Operational Classification (OC):	
Site Class:	
Bridge Seismic Level of Design:	

Select Design Earthquake	
SEE – 3% Probability of Exceedance in 75 years	☐
FEE – 15% Probability of Exceedance in 75 years	☐

Geologically Realistic ☐ **Hard Rock Basement Outcrop** ☐

Requestor Information	
Requestor Name:	
Company Name:	
Phone Number:	( ) -
Email Address	
Request Date:	

[1]**RPG – Regional Production Group**

Lowcountry – Beaufort, Berkeley, Charleston, Colleton, Dorchester, Hampton, Jasper
Pee Dee – Chesterfield, Clarendon, Darlington, Dillon, Florence, Georgetown, Horry, Kershaw, Lee, Marion, Marlboro, Sumter, Williamsburg
Midlands – Aiken, Allendale, Bamberg, Barnwell, Calhoun, Chester, Fairfield, Lancaster, Lexington, Newberry, Orangeburg, Richland, Union, York
Upstate – Abbeville, Anderson, Cherokee, Edgefield, Greenville, Greenwood, Laurens, McCormick, Oconee, Pickens, Saluda, Spartanburg

Consultant Seismic Information Request

PROJECT INFORMATION	
File No.	**PCN:**

TIME SERIES GENERATION REQUEST

Time Series information is required if a Site-Specific Response Analysis is to be conducted. The SCDOT Geotechnical Design Manual requires a Site-Specific Response Analysis for Seismic Site Class "F". Unscaled and Scaled time series will be generated for the **B-C Boundary** in Shake91 data format. The Scaled time series are based on the earthquake magnitude (Mw) and Epicentral distance provided.

Request Time Series: Yes ☐ No ☐

Sediment Thickness

The sediment thickness is used by *SCENARIO_PC*, to generate the time series simulation. The time series can be generated with the default sediment thickness as indicated in *2.2.2.1 Site Response Modeling* of the *Seismicity Study Report* (http://www.scdot.org/doing/pdfs/Reporttxt.pdf) or can adjusted specifically for the geology and analysis requirements at the specific project location. This option only applies to those site were the Geologically Realistic Model is used.

Change Sediment Thickness: Yes meters **No ☐**

Match Entire Uniform Spectrum

In cases where the uniform hazard spectrum is dominated by a single scenario (a well defined modal event in the Deaggregation plots), the spectrum of the modal event may closely match that of the uniform hazard spectrum, even without much scaling. This will be the case for sites in the Coastal Plain near Charleston, for the 3% in 75 year hazard level. However, at sites where there are two or maybe 3 modes in the deaggregation, matching the entire spectrum with a single modal event will require much scaling. This scaling can be done automatically over the entire spectrum. Matching the entire spectrum involves a phase-invariant spectral scaling of the scenario time series. It is often preferable to use two or more modal events, each matching a specific frequency of the uniform hazard spectrum. This results in a simple constant (frequency independent) scaling of the scenario time series. If the consultant selects to not match the entire spectrum, the spectrum may be scaled using either an oscillator frequency/PSA or a PGA that will be matched when simulating the ground motion.

Match Entire Spectrum:	**Yes ☐**	**No ☐**		
		Scaling Parameter	**M_{w1}**	**M_{w2}**
If Not matching Entire Spectrum, Select PSA or PGA Scaling	**PSA Scaling ☐**	**Oscillator Frequency**	**Hertz**	**Hertz**
		PSA	**g**	**g**
	PGA Scaling ☐	**PGA**	**g**	**g**

Scenario Earthquake Magnitude and Distance

Determine earthquake magnitude, M_W, and epicentral distance from the deaggregation plots provided by the U.S. Geological Survey (http://eqint.cr.usgs.gov/deaggint/2002/index.php). The 3% and 15% in 75-year events are equivalent to the 2% and 10% in 50-year events, respectively.

M_{W1} =	**Epicentral Distance =**	Kilometers
M_{W2} =	**Epicentral Distance =**	Kilometers

Consultant Geotechnical Seismic Response

To:	
Consultant:	
Date Requested:	

PROJECT INFORMATION

File No.	**PCN:**
County:	**Route:**
Description:	
Latitude (4 decimals): .	**Longitude (4 decimals):** .

Bridge Operational Classification (OC):	
Type of Seismic Information Requested:	
Site Class:	

Pseudo-Spectral Acceleration (PSA)

The SCDOT Geotechnical Design Section has generated the required Design Earthquake the pseudo-spectral acceleration (PSA) oscillator response for frequencies 0.5, 1.0, 2.0, 3.3, 5.0, 6.7 and 13 Hz, for 5% critical damping and peak horizontal ground acceleration (PGA) at the **B-C Boundary.**

SEE – 3% Probability of Exceedance in 75 years

PSA and PGA as Percentage of g

0.5Hz	1.0Hz	2.0Hz	3.3Hz	5.0Hz	6.7Hz	13.0Hz	PGA

Thickness of sediments: meters

FEE – 15% Probability of Exceedance in 75 years

PSA and PGA as Percentage of g

0.5Hz	1.0Hz	2.0Hz	3.3Hz	5.0Hz	6.7Hz	13.0Hz	PGA

Thickness of sediments: meters

Time Series

Unscaled and Scaled time series were generated for the **B-C Boundary** in Shake91 data format. The Scaled time series are based on the earthquake magnitude (Mw) and Epicentral distance requested.

The Time Series Files are Attached:	**Yes** ☐	**No** ☐

Design Response Spectrum

Two-Point Method	☐
Three-Point Method	☐

The Design Response Spectrum is Attached:	**Yes** ☐	**No** ☐

Geotechnical Designer:		**RPG[1]:**	
Date:		**Phone Number:**	( ) -
Geotechnical Review:		**RPG[1,2]:**	

[1]**RPG – Regional Production Group**

Lowcountry – Beaufort, Berkeley, Charleston, Colleton, Dorchester, Hampton, Jasper
Pee Dee – Chesterfield, Clarendon, Darlington, Dillon, Florence, Georgetown, Horry, Kershaw, Lee, Marion, Marlboro, Sumter, Williamsburg
Midlands – Aiken, Allendale, Bamberg, Barnwell, Calhoun, Chester, Fairfield, Lancaster, Lexington, Newberry, Orangeburg, Richland, Union, York
Upstate – Abbeville, Anderson, Cherokee, Edgefield, Greenville, Greenwood, Laurens, McCormick, Oconee, Pickens, Saluda, Spartanburg

[2]**RPG – Preconstruction Support – Geotechnical Design Section (PCS/GDS)**

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0410

TO: RPG Structural Engineers
Design Consultants

DATE: July 22, 2010

RE: *SCDOT Bridge Design Manual*
Revisions to Chapter 6

Figures 6.3-5, 6.3-6, and 6.3-7 of the *SCDOT Bridge Design Manual* shall be deleted and replaced with the attached figures.

Please note these revisions in your copy of the *Manual.*

Original Signed by Barry W. Bowers on July 22, 2010 for
Preconstruction Support

BWB:afg
Attachment
ec: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

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Pile Bearing	
	One Pile
Factored Design Load	70 tons
Geotechnical Resistance Factor	0.40
Nominal Resistance	175 tons
Estimated loss of Resistance due to Scour	20 tons
Estimated loss of Resistance due to Downdrag	10 tons
Required Driving Resistance	205 tons

Note: Method of controlling installation of piles and verifying their capacity: Pile Installation Chart from Wave Equation analysis without stress measurements during driving.

Drivability Analysis	
Skin Quake (QS)	0.10 in
Toe Quake (QT)	0.08 in
Skin Damping (SD)	0.20 s/ft
Toe Damping (TD)	0.15 s/ft
% Skin Friction	80%
Distribution Shape No.	1
Bearing Graph	Proportional
Toe No. 2 Quake	0.15 in
Toe No. 2 Damping	0.15 s/ft
End Bearing Fraction (Toe No. 2)	0.95
Pile Penetration	80%
Hammer Energy Range	25 – 60 ft-kips

PILE LOAD AND RESISTANCE TABLES

Figure 6.3-5

Drilled Shaft Bearing	
Factored Design Load	370 tons
Factored Resistance – Side	370 tons
Factored Resistance – End	0
Geotechnical Resistance Factor – Side	0.50
Geotechnical Resistance Factor – End	0.50
Total Nominal Resistance	740 tons

DRILLED SHAFT BEARING

Figure 6.3-6

Maximum Footing Reaction	
Factored Design Load (includes 3 ft of backfill)	295 kips
Factored Net Bearing	4.6 ksf
Geotechnical Resistance Factor	0.45
Required Net Nominal Bearing Resistance	10.2 ksf

Note: If footings of different types are used in the design, include a load table for each type of footing.

MAXIMUM FOOTING REACTIONS

Figure 6.3-7

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0510

TO: RPG Structural Engineers
Design Consultants

DATE: October 22, 2010

RE: *SCDOT Geotechnical Design Manual*, Version 1.1
Revisions to Chapter 21

Section 21.1 of the *SCDOT Geotechnical Design Manual* shall be updated by replacing the first bullet item, "Geotechnical Base Line Report," with the following:

- Geotechnical Information Reports
  a. Geotechnical Subsurface Data Report
  b. Geotechnical Base Line Report

The following sentence shall be inserted at the beginning of the second paragraph of Section 21.1:

> The Geotechnical Subsurface Data Report (GSDR) is used to convey geotechnical information on traditional design-bid-build projects.

Section 21.2 of the *Manual* shall be deleted and replaced with the following:

21.2 GEOTECHNICAL INFORMATION REPORTS

21.2.1 Geotechnical Subsurface Data Report (GSDR)

The GSDR is used to convey only geotechnical subsurface information for use by a contractor and is typically used with traditional design-bid-build projects. A GSDR does not provide any engineering interpretations or engineering analysis (preliminary or final). A GSDR shall include an introduction, a project description and any procedural variations from the field or laboratory testing methods as described in this Manual. The Appendices should at a minimum contain project and testing location plans, field exploration records (soil test boring logs, cone penetrometer and dilatometer records, etc.), and the results of all laboratory testing. Each field exploration record should contain the location of the testing and should correspond to the testing location plan. The laboratory testing results should clearly indicate the location and depth of each

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sample on the test result. In addition, all laboratory testing results should be presented in a tabularized format as a summary, prior to the presentation of results of individual testing.

21.2.2 Geotechnical Base Line Report (GBLR)

The GBLR is used to provide limited (preliminary) geotechnical information on a design-build project, thus permitting the contractor to bid on the project with a certain degree of knowledge and acceptable risk. A GBLR provides limited engineering interpretations or very preliminary engineering recommendations. The GBLR should be used in conjunction with project specific design-build criteria. The GBLR should contain at a minimum an introduction, project description, objective and scope of the geotechnical exploration and general recommendations concerning foundations and/or ground improvement requirements. A discussion of any procedural variations from the field or laboratory testing methods as described in this Manual shall also be included. The narrative portion of this type of report is anticipated to be relatively short, with the Appendices of the report being large. The Appendices should at a minimum contain project and testing location plans, field exploration records (soil test boring logs, cone penetrometer and dilatometer records, etc.), and the results of all laboratory testing. Each field exploration record should contain the location of the testing and should correspond to the testing location plan. Any guides used to interpret the data should also be included. The laboratory testing results should clearly indicate the location and depth of each sample on the test result.

Section 21.6 of the *Manual* shall be deleted and replaced with the following:

21.6 SUBMISSION REQUIREMENTS

All reports submitted to SCDOT shall be signed and sealed by a Professional Engineer as required by South Carolina law. All preliminary and draft reports shall be submitted electronically. After reviews have been completed, one bound, color copy of each final report shall be submitted along with a CD containing an electronic copy (.pdf). Electronic copies shall also be in color and include all Appendices. The CD containing the electronic copy shall be labeled to include the name of the project, the route or road number, the SCDOT file number, and the name of the geotechnical consulting firm. The CD shall also be labeled as preliminary or final and shall indicate whether the copy is draft or revised.

Please note these revisions in your copy of the *Manual.*

To assist contractors during their bid preparation, the Geotechnical Subsurface Data Report will be placed on the SCDOT Construction Extranet website along with the project plans and proposal.

Original Signed by N. Peter Yeh on October 22, 2010 for
Preconstruction Support

NPY:afg
ec: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File: PC/BWB

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0111

TO: RPG Structural Engineers
Design Consultants

DATE: March 7, 2011

RE: Drilled Shafts – Revisions to Sections 12.5.3.2, 15.3.1.2, 19.3.3, and 20.3.2.1 of the *SCDOT Bridge Design Manual* and Sections 16.4 and 22.2.1.2 of the *SCDOT Geotechnical Design Manual*

To address some recent issues involving drilled shaft construction, Sections 12.5.3.2, 15.3.1.2, 19.3.3, and 20.3.2.1 of the *SCDOT Bridge Design Manual* and Sections 16.4 and 22.2.1.2 of the *SCDOT Geotechnical Design Manual* shall be revised as described in the following paragraphs.

In Section 12.5.3.2 of the *SCDOT Bridge Design Manual*, the second sentence of the first paragraph shall be deleted.

Figure 15.3-2 in Section 15.3.1.2 of the *SCDOT Bridge Design Manual* shall be revised to require a 4-inch minimum concrete cover for drilled shafts in both soil and rock conditions. This minimum cover must be provided to the transverse reinforcement.

In Section 19.3.3 of the *SCDOT Bridge Design Manual*, Item 5 shall be deleted and Items 1 and 2 shall be deleted and replaced with the following:

1. Location of Top of Shaft. The top of drilled shafts should be set at the higher of either the ground line or 5 feet above the water elevation expected during construction. Typically, the tops of drilled shafts within a bent are set at the same elevation. Also, the elevations of the tops of shafts from bent to bent are usually set at the same elevation in water and in flat land areas such as floodplains. If the distance from the top of a shaft to the bottom of a bent cap is less than 5 feet, the Contractor should be given the option, at no additional cost to SCDOT, of extending the shaft to the bottom of the bent cap.

2. Casing for Shafts. Unless approved otherwise by the Regional Production Engineer, all shafts shall be detailed with construction casing. The portion of the shaft below the bottom of the casing, whether in soil or rock, shall be detailed with a diameter that is six inches smaller than the diameter of the

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construction casing. To provide a construction tolerance, the bridge design shall include provisions for allowing the top and bottom of casing to be raised or lowered 2 feet. The casing shall not be considered in the determination of the structural resistance of the shaft. However, it should be considered when evaluating the seismic response of the foundation because the casing will provide additional resistance.

In Section 20.3.2.1 of the *SCDOT Bridge Design Manual*, the second paragraph shall be deleted and replaced with the following:

Where supported on drilled shafts, a minimum of 3 inches should be detailed from the edge of shaft to the edge of column at the column/shaft interface. If the column supported on a drilled shaft would be less than 5 feet tall, the Contractor should be given the option, at no additional cost to SCDOT, of extending the shaft to the bottom of the bent cap. On projects with large water elevation fluctuations, provide for permissible construction joints in casings and shafts to facilitate construction. Detail the permissible construction joint in the shaft a minimum of 2 feet below the permissible construction joint in the casing.

In Section 16.4 of the *SCDOT Geotechnical Design Manual*, the second paragraph shall be deleted and replaced with the following:

Drilled shaft sizes (diameters) can range from 30 inches (2-1/2 feet) to 144 inches (12 feet). Drilled shaft sizes typically used by SCDOT range from 42 inches (3-1/2 feet) to 84 inches (7 feet) in diameter. Drilled shaft diameters should be a minimum of 6 inches larger than the column above the shaft. Unless approved otherwise by the Regional Production Engineer, all shafts shall be detailed with construction casing. The portion of the shaft below the bottom of the casing, whether in soil or rock, shall be detailed with a diameter that is six inches smaller than the diameter of the construction casing.

In Section 22.2.1.2 of the *SCDOT Geotechnical Design Manual*, the first paragraph shall be deleted and replaced with the following:

The following Plan Notes apply to drilled shafts. Drilled shafts are typically used at interior bents only, but Plan Notes are also required if drilled shafts are used at end bents. The geotechnical designer typically determines the bottom elevation of the casing. In dry environments, the top of casing elevation should be set at the ground line. In wet or fluctuating water environments, the top of casing elevation should be set 5 feet above the water elevation expected during construction. If the column supported on a drilled shaft would be less than 5 feet tall, the Contractor

should be given the option, at no additional cost to SCDOT, of extending the shaft to the bottom of the bent cap. The designer shall also provide for permissible construction joints in casings to facilitate construction on projects with large water elevation fluctuations. The notes and tables included herein are generic in nature and should be made project specific. Underlined capital letters are used to indicate areas where project specific information is required. In addition, when the tables presented herein include numbers, these numbers shall be changed to the requirements of specific projects.

The above revisions shall apply to all projects where the substructure design has not been substantially completed.

Original Signed by James W. Kendall, Jr.
on March 7, 2011

James W. Kendall, Jr.
Preconstruction Support Engineer

JWK:rga
ec: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File:PC/BWB

South Carolina
Department of Transportation

BRIDGE DESIGN MEMORANDUM – DM0211

TO: RPG Structural Engineers
Design Consultants

DATE: July 7, 2011

RE: *SCDOT Geotechnical Design Manual*, Version 1.1
Revisions to Chapters 4, 8, 9, 10, and 17

The first paragraph of Section 4.3 of the *SCDOT Geotechnical Design Manual* shall be amended by inserting the following sentence between the fifth and sixth sentences:

> Any requests to deviate from these minimum requirements shall be made in writing and shall be forwarded to the PCS/GDS for consideration. All testing shall be to a sufficient depth to effectively evaluate the appropriate limit state conditions and shall fully penetrate any formation that will affect performance (e.g., settlement or slope instability of a roadway embankment or roadway structure).

The paragraph in Section 4.3.3 of the *Manual* shall be deleted and replaced with the following paragraph:

> All roadway embankments shall have one testing location at least every 500 feet along the roadway embankment. In addition, roadway embankments within 150 feet of a bridge end shall have a minimum of two testing locations; one at the bridge end (which is also used for bridge foundation design) and one at a point 150 feet from the bridge end. The testing location 150 feet from the bridge end must be to a depth that is sufficient to effectively evaluate Extreme Event I limit state for the roadway embankment design.

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Table 8-11 of the *Manual* shall be deleted and replaced with the following table:

Table 8-11, Roadway Structure Operational Classification (ROC)

Roadway Structure Operational Classification (ROC)	Description
I	Roadway embankments located within 150 feet of a bridge with OC = I. Roadway structures located within 150 feet of a bridge with OC = I. Rigid walls with heights greater than 15 feet. Flexible walls with heights greater than 50 feet.
II	Roadway embankments located within 150 feet of a bridge with OC = II. Structures (not classified as ROC = I) located within 150 feet of a bridge with OC = II.
III	Roadway embankments located within 150 feet of a bridge with OC = III. Structures (not classified as ROC = I) located within 150 feet of a bridge with OC = III. Structures (not classified as ROC = I) located more than 150 feet from a bridge.
IV	Roadway embankments located more than 150 feet from a bridge.

Chapters 9 and 10 of the *Manual* shall be amended to include a Roadway Structure Operational Classification (ROC) = IV. All embankments classified as ROC = IV shall be designed and evaluated for the strength and service limit states. Unless approved otherwise by the Director of Preconstruction, embankments classified as ROC = IV shall only be designed and evaluated for Extreme Event I limit state when all of the following conditions exist:

- The embankment is a causeway (i.e., an embankment constructed over marshy land or in water).
- The embankment is located on a route that has no detour.
- The embankment is located on a route having a current ADT that equals or exceeds 3000 vpd.

The resistance factors (Chapter 9) and performance limits (Chapter 10) for embankments classified as ROC = IV shall be the same as the requirements for embankments classified as ROC = III.

Section 10.2.2 of the *Manual* shall be amended by inserting the following paragraph between the second and third paragraphs:

> The Service and Damage Level descriptions in Tables 10-1 and 10-2 are intended to apply to bridges and roadway structures other than embankments. Because soils found in-place and within embankments may significantly vary within short distances both vertically and horizontally due to South Carolina geology, it is difficult to associate closure time and degree of collapse along a continuous embankment. Generally, it is not economically feasible to entirely prevent failure of an embankment due to a seismic event. Observations from past earthquakes around the world indicate that embankment failures are isolated and discontinuous after a seismic event and the accessible area along the top of the embankment has for the most part remained traversable. Based on these observations, embankments that are not designed for seismic events should still be traversable even though they may exhibit significant damage that will require repair.

The paragraph and table (Table 10-27) in Section 10.7.2.1 of the *Manual* shall be deleted and replaced with the following paragraph:

> The Performance Objective for embankments at Extreme Event I limit state is that the embankments remain stable during the seismic design event. For embankments adjacent to structures, this objective is based on the potential for the embankments to contribute to the collapse of the structure should the embankments fail.

In Section 17.1 of the *Manual*, the third paragraph shall be deleted and replaced with the following:

> Embankments with heights less than 3 feet and slopes of 2H:1V or flatter generally do not require stability analysis. However, for all embankment heights, the calculated settlement values must conform to the applicable performance limits.

These revisions shall apply to all projects where design has not been substantially completed.

Original Signed by James W. Kendall, Jr.
on July 7, 2011

James W. Kendall, Jr., P.E.
Preconstruction Support Engineer

JWK:afg
ec: Bridge Construction Engineer
Bridge Maintenance Engineer
FHWA Structural Engineer
Preconstruction Support Managers
Regional Production Engineers
RPG Design Managers
File:PC/BWB